"COMPARATIVE STUDY BETWEEN LIGHT WEIGHT MESH VERSUS STANDARD PROLENE MESH IN LICHTENSTEIN'S HERNIA REPAIR"

Submitted By

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In partial fulfillment of the

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MASTER IN SURGERY

In

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Under the guidance of

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B. L. D. E. U' S

SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL & RESEARCH CENTRE, BIJAPUR

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I hereby declare that this dissertation entitled **"COMPARATIVE STUDY BETWEEN LIGHT WEIGHT MESH VERSUS STANDARD PROLENE MESH IN LICHTENSTEIN'S HERNIA REPAIR"** is a bonafide and genuine research work carried out by me under the guidance of **Dr .M. B. PATIL** M.S. Professor ,Dept. Of General Surgery, BLDEU'S Shri B. M. Patil Medical College Hospital & Research Centre Bijapur.

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Date:

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LIST OF ABBREVIATIONS

AD	-	Anna domino: After Christ
ASIS	-	Anterior Superior Iliac Spine
BC	-	Before Christ
B.D	-	Bis in die: Twice a
cms	-	Centimeters
COPD	-	Chronic Obstructive Pulmonary Disease
etal	-	And Associates
F	-	Female
M	-	Male
Fig. No.	-	Figure Number
gms	-	Grams
i.e.	-	That is
IP No	-	In Patient number
Lig	-	Ligament
LMR	-	Lichtenstein's Mesh Repair
Lt	-	Left
Rt	-	Right
MBR	-	Modified Bassini's Repair
mg	-	Milligrams
Nos	-	Numbers
P	-	Probability (Significance of difference)
Sl. No.	-	Serial Number
TAPP	-	Trans Abdominal Pre Peritoneal

TEP	-	Total Extra Peritoneal
Vs	-	Versus
H/S/O	-	History suggestive of
PT	-	Pubic tubercle
WNL	-	Within normal limit
IHD	-	Ischemic heart disease
YRS	-	Years
NS	-	Not significant
HS	-	Highly significant
VAS	-	Visual analogue scale
LWM	-	Lightweight mesh
SPM	-	Standard prolene mesh
P+S	-	Pain + Swelling
Mths	-	Months
B/L	-	Bilateral
A+S	-	Alcoholic+ Smoker
A+T	-	Alcoholic+Tobacco chewer
BHP	-	Benign hyperplasia of prostate
DM	-	Diabetes mellitus
HTN	-	Hypertension
TB	-	Tuberculosis
D	-	Days
SD	-	Standard deviation
U	-	Mann Whitmy test
PA1M	-	Pain after 1 month

CPA3M	-	Chronic Pain after 3 months
CPA6M	-	Chronic Pain after 6 months
TTTRBTNAA3M	-	Time taken to return back to normal activity after 3 months
TTTRBTNAAM	-	Time taken to return back to normal activity after 6 months
LPWRDLO<10kg	-	Light physical work i.e. Repeating daily lifting of less than 10kg
FBS	-	Foreign body sensation

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INTRODUCTION

A hernia is a protrusion of a viscus or part of a viscus through an abnormal opening in the walls of its containing cavity. Inguinal hernia repair is the most frequently performed operation in any general surgical unit.

Since the introduction of surgical meshes for hernia in 1959 by Usher ,the main interest of hernia surgeons in the past decades was focused on surgical techniques to optimize hernia repair and the application of the mesh.

The trend changed in the early and mid 1990's in parallel with increasing number of case reports reporting mesh related complications after heavy mesh based hernia repair such as pain, seromas , discomfort, decreased abdominal wall mobility which are frequently observed in post mesh hernioplasty.

Complications such as chronic and persisting pain as well as infection, including fistula formation are rare.

These complications have been the rationale to examine the role of mesh in hernia repair in detail and to investigate the biocompatibility of different mesh modifications and to challenge old mesh concepts.

Prolene is a monofilament heavyweight polypropylene mesh (>85g/m^2) with small pores <1mm with high tensile strength at cheaper cost.

Ultrapro is a multifilament (polypropylene and polyglecaprone) lightweight mesh (28 g/m^2) with large pores 3-4 mm with lesser tensile strength but costlier.

AIM OF THE STUDY:

- To compare lightweight mesh with standard prolene mesh with respect to complications like pain, seroma formation, hematoma, wound infection rate, foreign body sensation, and time taken to return back to normal work{ A. light physical work repeating daily lifting of <10kg }

OBJECTIVES

To compare lightweight mesh with standard prolene mesh in Lichtenstein hernia repair with respect to pain, seroma ,hematoma and infection within 1 month of follow-up and chronic pain using visual analogue scale {3 to 6mths}, foreign body sensation, and time taken to return back to normal work { A. light physical work repeating daily lifting of <10kg} after 3 and 6 months.

REVIEW OF LITERATURE

Historical Aspects of Inguinal Hernia

"In the entire history of surgery, no subject has been controversial as the repair of groin hernia" — C.B. Mc Vay

CHRONOLOGY OF HERNIA SURGERY

ANCIENT TIMES:[1, 2]

The word hernia is derived from the Greek word '*Hernios*', meaning '*Nad*' or '*Shoot*'; a budding or bulge. Hernia is known to mankind since time immemorial. The Latin word Hernia means a *rupture or tear*.[3] Sushruta in Vedic period described hernia as '*Antra-vriddi*' and had thought it to be incurable. Hernia is barely mentioned in the writings of Hippocrates (500 BC).

The evolution of surgical treatment of inguinal hernia encompasses the trials and errors of surgeons practicing their art, for thousands of years.

1500 BC - Inguinal hernia described in Egypt in 'Eber's papyrus' Egyptian physicians reported the management of hernia by conservative means that included the snugly fitting bandage for reduction and support.

900 BC - Tightly fitting bandages were used to treat inguinal hernia by physicians in Alexandria.

400 BC - ***Hippocrates*** described the difference between Hernia and Hydrocele through transillumination.

40AD - ***Aurelius Celsus*** described old Greek operation - through an incision in the neck of the scrotum, the hernial sac was dissected off the spermatic cord and transected at the external ring. Documented use of transillumination to distinguish hydroceles

from hernias and described taxis for strangulation

200 AD - ***Galen*** - introduced the concept of rupture of peritoneum, who without dissecting the human body conceived that herniation was produced by rupture of the peritoneum with stretching of overlying fascia and muscles.

700 AD - ***Paul*** of Aegian described complete (Scrotal) and incomplete (Bubonocele) herniae. He recommended amputation of the testicle in repair.

MEDEVIAL PERIOD-THE BARBER SURGEONS:[4]

After the fall of Rome, religious prejudice against mutilation of the human body caused regression of surgical technique. The care of the sick was taken over by monks and priests and surgery was completely forbidden by followers of both Christianity and Islam. Operations were relegated to barbers, hangmen and itinerant 'Incisors'. Self-taught, with secrets handed down within families, such people generally were unable to read Latin or Greek and thus were prevented from developing profession.

1363 ***Guy de Chauliac*** from France distinguished Inguinal and Femoral hernia in his text 'Chirurgia Magna'. He developed taxis for incarcerated hernia, recommending the head down Trendelenberg position.

1383 ***Ronald***, of Parma, recommended the use of Trendelenberg position in the management of hernias.

1556 ***Pierre Franco***[8] of Switzerland recommended dividing the constriction at the neck of a strangulated hernia sac, using a grooved director to protect the bowel. During the late middle ages, the Medice

and Borgia Popes granted permission for dissection, in order to encourage painters and sculptors to do better work.

RENAISSANT:[5,6]

After the renaissance, autopsy and anatomic dissection spread throughout Europe. Started in Bologna in 1200 AD, knowledge about herniation accumulated rapidly.

1700 - ***Litter*** reported a Meckle's diverticulum in a hernial sac.

1721 - ***William Cheselden*** (1688-1752) successfully operated on strangulated Hernias.

1724 - ***Heister*** distinguished direct and indirect hernia in his monograph. He successfully resected bowel of patient with strangulated hernia.

1731 - ***De Gimbernat*** described the ligament that bears his name and advocated its division in instances of strangulated femoral hernias.

1757 - ***Percival Pott*** of London described anatomy of hernia and of strangulation.

1785 - ***Richter*** described a partial enterocele.

l804 - ***Astley Patson Cooper*** (1768 - 1841)[9], published his two part book on hernia. Described for the first time the superior pubic ligament, which bears his name and transversalis fascia with full recognition of its role in the pathogenesis of hernias.

1809 - ***Antonio Scarpa*** (1752 - 1832)[10], in his treatise on hernia accurately described the sliding hernia, based on autopsy studies and stressed the importance of understanding the anatomy to study the varieties of hernias.

1811 - ***Colle*** described the reflected inguinal ligament.

1816 - ***Franz Casper Hesselbach*** (1759 - 1816)[1] described anatomy of his triangle, Iliopubic tract and his (Hesselbach's) fascia (cribriform fascia over the femoral canal)

Jules German Cloquet (1770 - 1883) pointed out that the peritoneum was actually displaced and not ruptured in the formation of hernia sac. He described the patency of processus vaginalis.

1846 - Anaesthesia was discovered.

Despite these important advances, surgical repair made a slow progress in the first half of the 19th century, as any attempt to open the inguinal canal was followed by severe sepsis and recurrence of the hernia.

LISTERIAN:[1]

1867 - ***Joseph Lister***, Professor of Orthopedic Surgery at Glasgow infirmary presented his first paper on antiseptic surgery performed under carbolic acid spray and carbolised catgut.

1869 - ***Mac Ewan*** recognized the importance and the role of transversalis fascia in the repair of hernia. He obliterated the inguinal canal with mattress sutures.

1871 - ***Marcy. H. O*** (1837 - 1924), a pupil of Lister described his operation. He published the first article in USA on Antiseptic herniorrhaphy, using carbolised catgut ligature. He was the first to indicate the importance of the high ligation of the hernial sac and closure of dilated inguinal ring as essential steps in the repair of inguinal hernia. He was also the first to describe, the trans-abdominal approach.

1876 - ***Thomas Annandale*** of Edinburgh presented for the first time the concept of the pre-peritoneal approach.

1877 - ***Czerny*** described pulling the sac down through the external ring and excising it, allowing the ligated neck to retract and invert at internal ring The period 1880-90, has rightly been termed as ***'The Decade of Inguinal Hernia'***, for the significant contributions made towards hernia surgery by Lucas Championniere, Marcy and Bassini.

1885 - ***Lucas Championniere. J*** incised the external oblique aponeurosis, laid open the inguinal canal and imbricated the roof in the closure.

1887 - ***Edorado Bassini*** *(Father of Modern Herniorrhaphy)* (1844 – 1924)[7] of Pavia, Italy published the first description of his operation revolutionized the treatment of inguinal hernia by the introduction of a technique designed to restore the conditions in the area of hernial orifice, which existed under normal circumstances.

1889 - ***William S Halsted*** (1852 - 1922) independently developed a similar procedure to that of Bassini's with few differences, which included the laying open of all three musculoaponeurotic layers, reforming the internal ring after strengthening the posterior wall and transplantation of the cord to a subcutaneous position and debulking the cord - ***Halsted I procedure***

1890 - ***Bassini***[10,11] published his epoch making report of 206 cases of hernia operations, with very low mortality and recurrence rates.

Advocated to reconstruct the inguinal canal physiologically, recreating the internal and external openings with anterior and posterior walls.

1893 - ***Lockwood*** emphasized the importance of adequate repair of fascia transversalis.

1898 - ***Lotheissen*** used Cooper's ligament for repair of inguinal hernia.

MODERN ASEPTIC:

The basic principles of hernia repair were laid down in late 19th century and modifications were made in Bassini's procedure with local anesthesia being advantageously used.

1903 - *Halsted - II*[4] Operation by ***Ferguson*** and ***Andrew***

1919 - ***George Paulla Roque*** (1876 - 1934) advocated the transabdominal approach for absolute assurance of ligating the hernial sac high up.

1920 - ***George Lenthal Cheatle*** renewed the interest in the pre-peritoneal approach to groin hernioplasty through a Pfannenstiel type incision.

William Edward Gallie (1882 - 1959)[12,13] and ***Lemesurier***, published papers on using autologous fascia lata strips as sutures woven into the muscles and the inguinal ligament and the tissues of the posterior wall.

1936 - ***Henry*** - Extraperitoneal approach to groin hernia

1940 - ***McVay*** and ***Anson*** pointed out that, the rectus fascia, a portion of the

transversalis fascia that inserts into the lateral border of rectus muscle, was strong enough to prevent incisional herniation.

1942 - ***Norman Cecil Tanner*** (1906 - 1982) presented a technique in which he utilized a relaxation incision of the rectus sheath to reduce the tension during the reinforcement of the posterior wall of the inguinal canal.[14]

Chester Bidwell McVay (1911 - 1987) repopularised the repair earlier proposed by ***George Lotheissen*** and ***Albert Narath***. The transversus layer (posterior inguinal wall) was sutured to the Cooper's ligament from pubic tubercle to the femoral vein which in turn obliterated femoral ring also.[15,16]

1950 - ***Koontz*** used tantalum gauze.

1953 - ***E.E. Shouldice*** performed multiple layer repair of posterior inguinal wall under local anesthesia (Shouldice technique) - a series of 8317 hernias - 10 year recurrence rate 0.8%.[17]

1958 - ***Usher*** - Use of knitted polypropylene mesh in hernia repair to buttress and reinforce previously sutured repair.

1960 - ***Lloyd Nyhus*** strongly recommended preperitoneal approach

1982 - ***Ger*** and his colleagues, through laparoscope, used Michel staples applied with a Kocher clamp to close peritoneal opening of the hernia sac.

1984 - ***Stoppa*** devised procedure for reinforcing peritoneum using large unslit prosthesis.

Read postulated an etiological relationship between smoking, inguinal herniation and aortic aneurysm.

1986 - ***Lichtenstein*** introduced tension-free repair by reconstructing floor of inguinal canal using prosthetic material.

1989 - ***Bogojavlensky*** reported his technique of filling an indirect hernia defect with plug of polypropylene mesh, followed by laparoscopic suture approximation of the internal ring. Studied iliopubic tract anatomically and used it for hernia repair. Devised technique for sutureless repair of inguinal hernia using prosthesis.

1991 - ***Gilbert*** used suture less repair of small to moderate sized inguinal hernia by cones and swatch.

1991 - ***Arreugiti*** introduced Transabdominal preperitoneal repair (TAPP) with full exposure of inguinal floor & placement of a preperitoneal prosthesis.

1992 - Intra peritoneal onlay mesh repair of groin hernia by ***Franklin*** and also Fitzgibbon ***I.B. McKernan***, ***E.H. Philips*** and ***Laws*** described totally extra peritoneal technique (TEP) of endoscopic hernioplasty for groin hernias, which avoids peritoneal cavity.

1993 - ***Robbins*** and ***Rutkow*** popularized a more controversial use of prosthetic materials - configured as swatch, plug or suture less patch (Mesh Plug repair). In this, a roll of material is placed in the hernial orifice with or without suture to obstruct the passage of hernia to the exterior.

Expanded polytetrafluroethylene (ePTFE) has been adopted for both the external and pre-peritoneal approach, with good results. In recent years, sheaths of woven monofilament polyamide or knitted monofilament polypropylene have been used extensively.

Recently, a bilayered patch[7] device for inguinal hernia has been introduced. The unique feature of this polypropylene mesh device is that it has three components. Its underlay patch provides posterior mesh repair. Its connector has the desirable attributes of the plug repair. Its onlay patch covers the posterior wall up to internal inguinal ring.

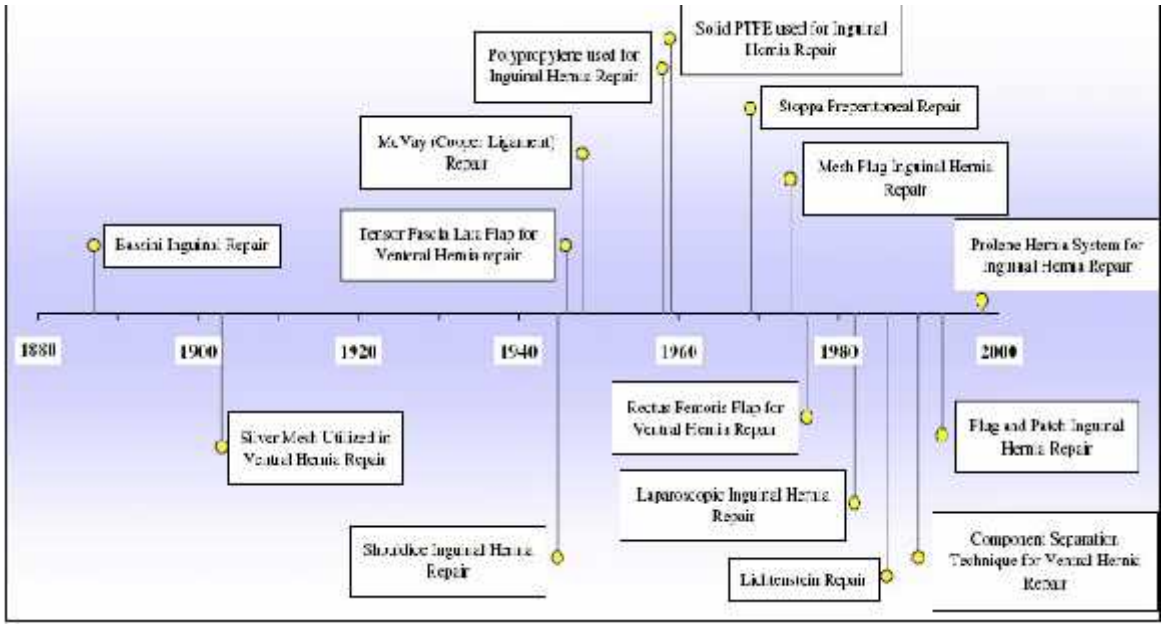


Fig.1. TimeLine of Hernia Repair

EMBRYOLOGY[18,19]

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

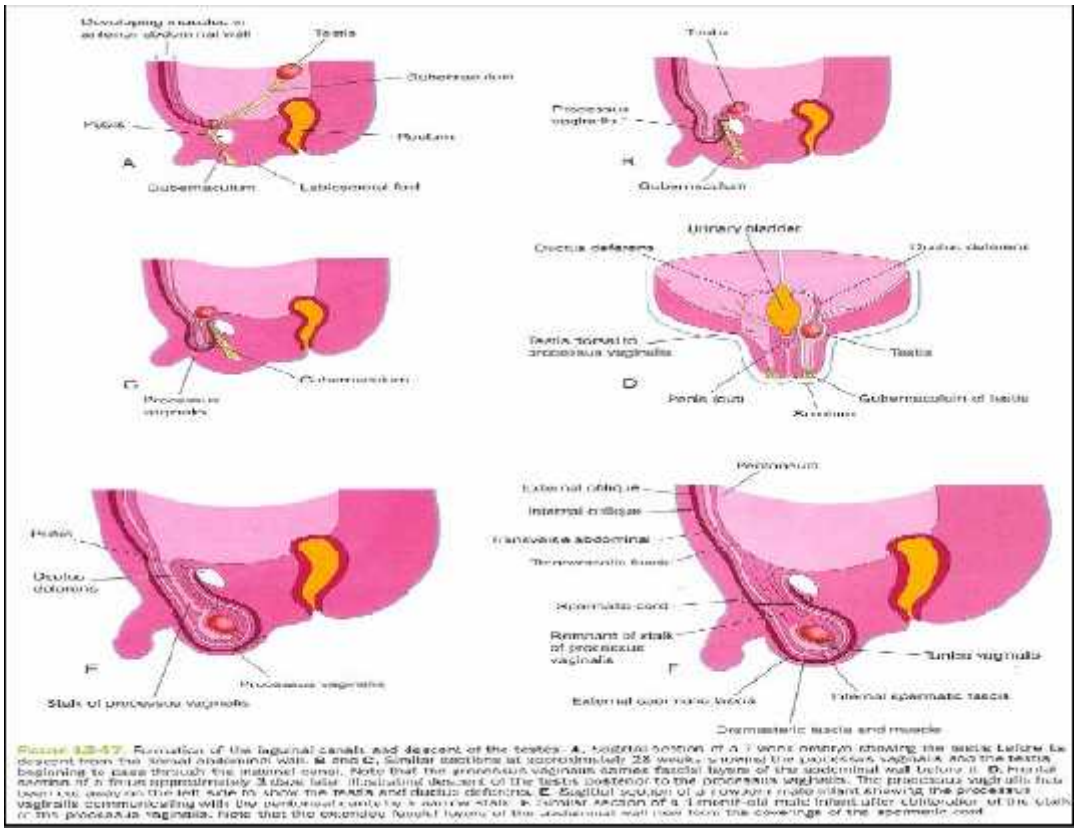


Fig 2: Embryology of Testicular Descent

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 attached by a peritoneal fold called mesorchism. Descent or migration of the testis into its corresponding scrotal chamber is accomplished by following the lead of the fibro muscular band- gubernaculums testis. It arises mainly within a peritoneal fold called the plica inguinalis, which stretches from the inguinal region to the lower end of mesonephrons, the gubernaculums attains the greatest development about the sixth month 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.

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 covering from the aponeurosis of the external oblique and internal oblique and from fascia tranversalis.

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

By the end of the eighth month the cavity of the upper part of the processus vaginalis disappears. The lower part of the processus vaginalis is entirely cut off from the general peritoneal cavity and consists of two layers, the parietal portion of the tunica vaginalis lining the scrotum, while visceral portion of that membrane is applied on to the surface of the testis. In female, the gubernaculums

extends from the lower poles of the ovaries to the labium majus through the inguinal canal. This part atrophies and is represented by the ligament of the ovary while the lower part which is developed is within the plica inguinalis is represented by the round ligament of the uterus, extending from the side of uterus to the labium majus. A pouch of peritoneum is called the canal of nuck, similar to the processus vaginalis in the male, accompanies the gubernaculums 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 the genesis of induction of inguinal hernia in the female.

ANATOMY[20,21,22]

"No disease of the human body belonging to province of surgeon required in its treatment, a better combination of accurate, anatomical knowledge with surgical skill, than hernia in all its varieties".

Sir Astley Patson Cooper, (1804)

The Latin word hernia means a rupture or tear. A hernia is a protrusion of a viscus or part of a viscus through an opening in the wall of the cavity in which it is contained.

Heister said "It is necessary for a surgeon to have complete, or at least very good, knowledge in anatomy as well as in medicine so that he has enough judgement and understanding to study all the cause and circumstances, and to draw his conclusions from them".

The inguinal canal is an oblique intermuscular slit about 4 cm long lying above the medial half of the inguinal ligament. It commences at the deep inguinal ring and ends at the superficial inguinal ring. It is directed downwards, forwards, and medially. In infants, the superficial and deep inguinal rings are almost superimposed and obliquity of canal is slight.

The deep inguinal ring is a U shaped condensation of the transversalis fascia and it lies 1.25cm above the inguinal ligament { Poupart's ligament } midway between the symphysis pubis and the anterior superior iliac spine.

The superficial inguinal ring is a triangular aperture in the aponeurosis of external oblique and lies 1.25 cm above the pubic tubercle. The ring is bounded by superomedial and inferolateral crus joined by criss cross intercrural fibres. Normally, the ring will not admit the tip of little finger. The inguinal ligament is the thick folded lower border of the aponeurosis of the external oblique presenting

a grooved superior abdominal surface { The floor of the inguinal canal }, and which stretches from the anterior superior iliac spine to the pubic tubercle. It has variously been called the crural arch, the superficial crural arch, and poupart's ligament.

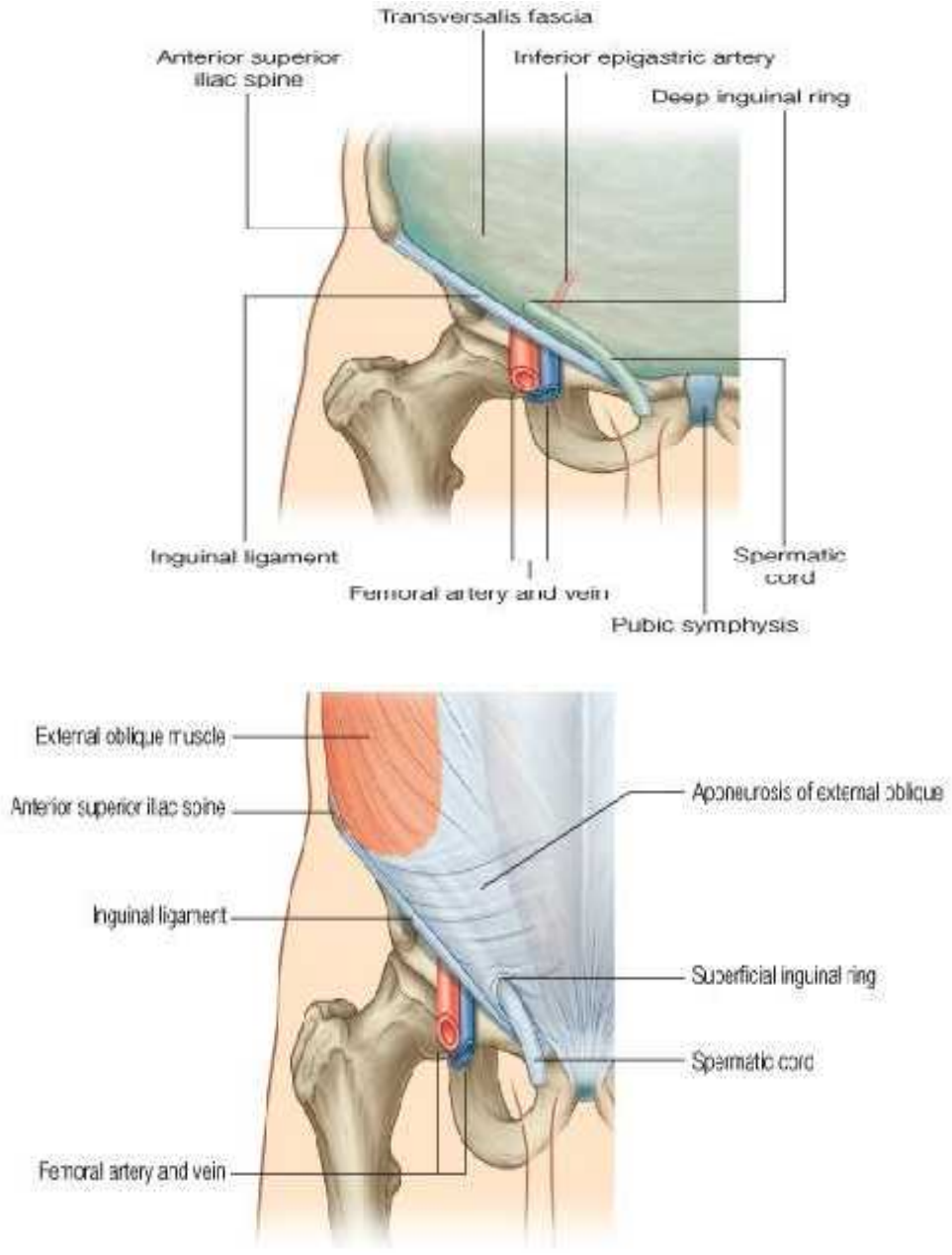


Fig. 3 : Anatomy of the Inguinal Canal

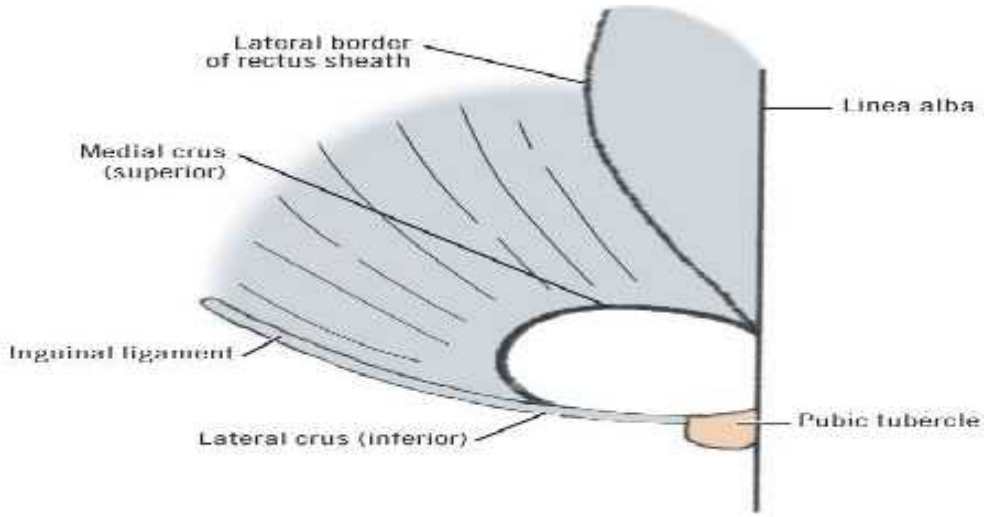


Fig 4: Superficial Inguinal Ring[23]

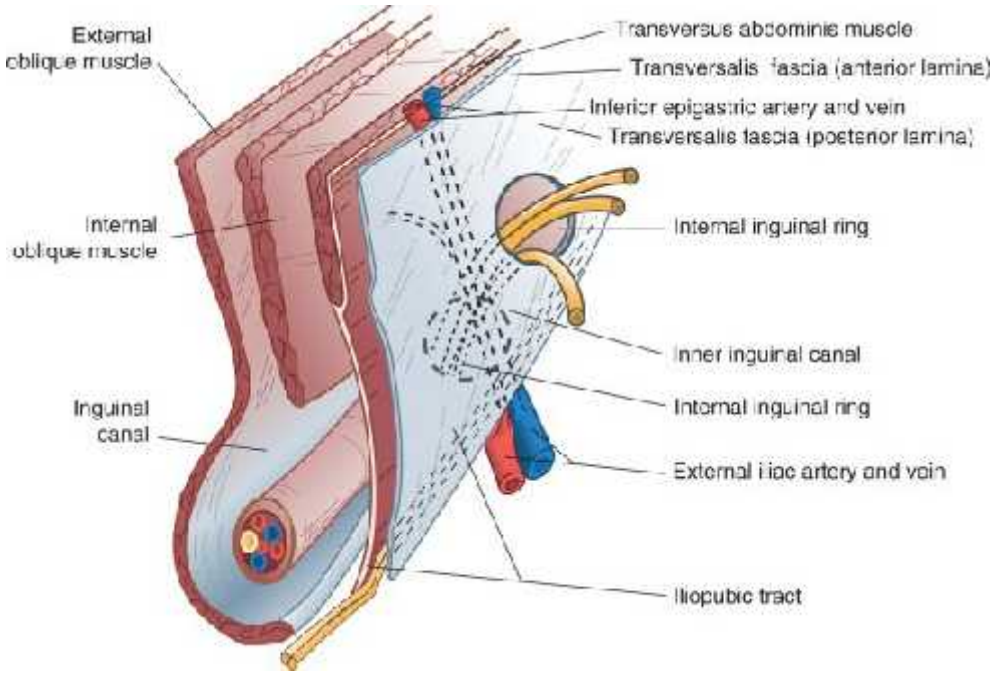


Fig 5: InguinalCanal[24]

Boundaries

Anterior wall is formed by the following In its whole extent

1. Skin
2. Superficial fascia
3. External oblique aponeurosis.

In its lateral 1/ 3 rd

Fleshy fibres of internal oblique muscle.

Posterior wall

In its whole extent

1. Fascia transversalis
2. Extraperitoneal tissue
3. Parietal peritoneum

In its medial 2/ 3 rd

Conjoint tendon.

Reflected part of inguinal ligament { Medial end }

In its lateral 1/ 3 rd

Interfoveolar ligament { When present} .

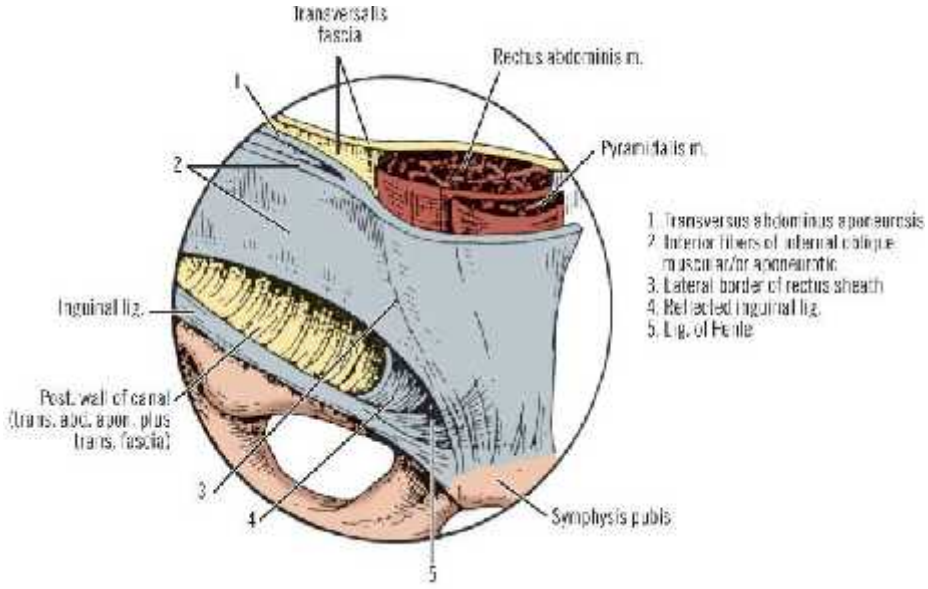


Fig 6: Conjoined Area

Roof

Arched fibres of internal oblique and transversus abdominus muscles.

Floor

Grooved upper surface of the inguinal ligament and at the medial end by the lacunar ligament.

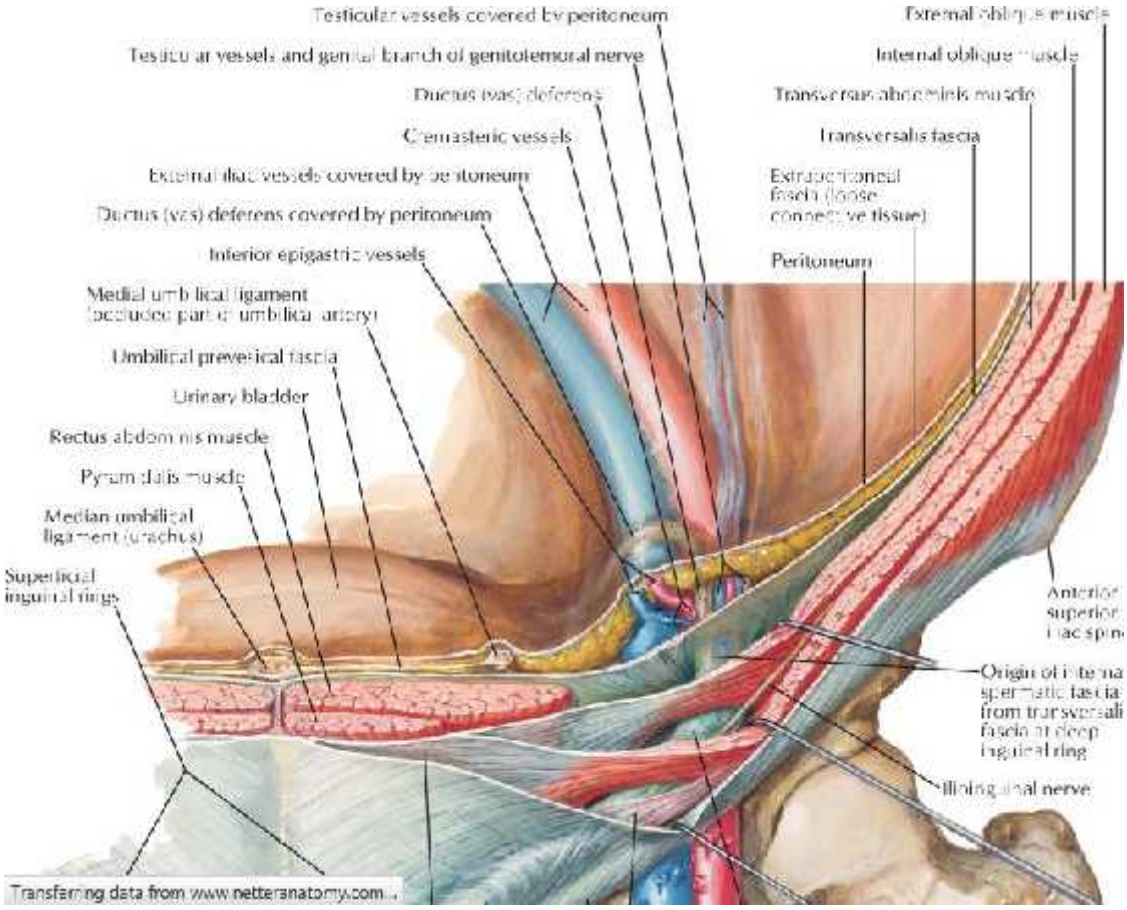


Fig. 7 : Boundaries of Inguinal Canal [33]

Structures passing through the canal

In males

Spermatic cord

Vas deference and its artery

Testicular artery[36]

Cremasteric artery[36]

Pampiniform plexus of veins

Obliterated remains of processus vaginalis

Genital branch of genitofemoral nerve

Autonomic nerves

Lymphatics

In females,

Obliterated Processes vaginalis

Round ligament

Lymphatics from the uterus

The ilioinguinal nerve, although is a content of the inguinal ring, does not enter the canal through the deep ring, but by piercing the internal oblique muscle i.e , it slips into the canal from the side not from the back. The nerve lies in front of the cord and leaves the canal through the superficial ring[43].

Hesselbach's Triangle[37]

Laterally - inferior epigastric artery.

Medially - outer border of rectus

Lower boundary - inguinal ligament

Hesselbach's triangle is divided into medial and lateral halves by the obliterated umbilical artery { Lateral umbilical ligament}.

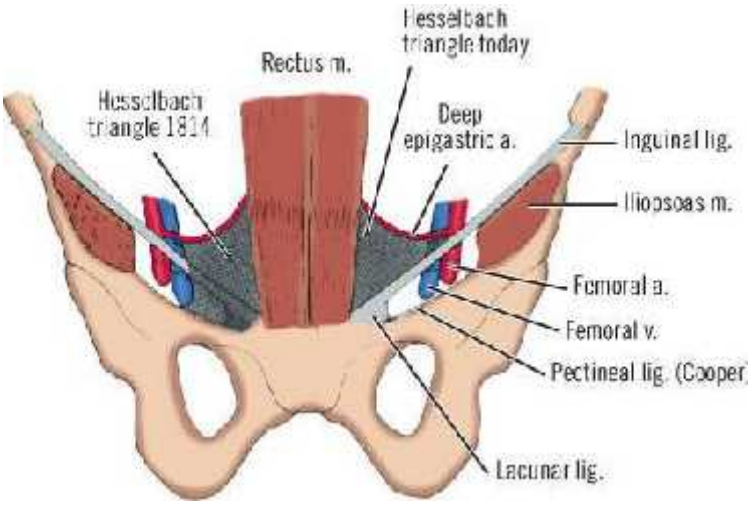


Fig 8: Hesselbach's triangle[24,25]

Transversalis Fascia[38]

Is considered to be the downward continuation of the transversalis muscle and its aponeurosis. The lower free margin of the muscle arches with the internal oblique muscle over the internal ring to form the transversus abdominus aponeurotic arch which in turn fuses with the internal oblique aponeurosis in 5 to 10% of cases to form the conjoint tendon.

Iliopubic Tract

Is a fibrous condensation of endoabdominal fascia that arises from the iliopectineal arch and inserts on the anterior superior iliac spine and inner tip of the wing of the ileum. The iliopubic tract is located at the inferior border of the deep inguinal ring.

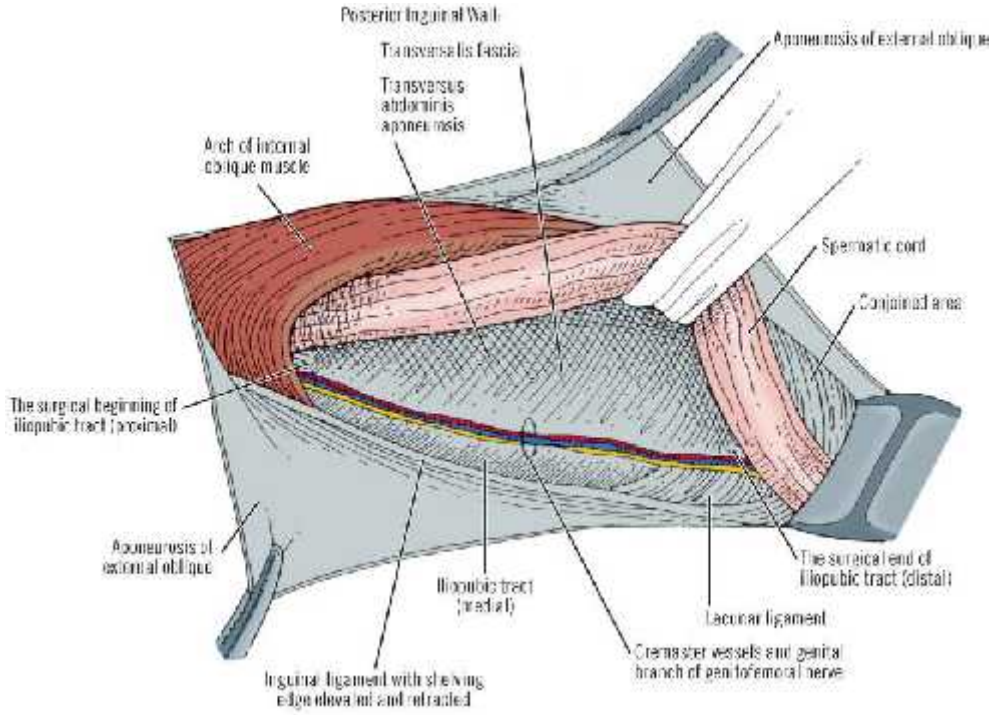


Fig 9: Iliopubic Tract.

Cooper's Ligament

Is located on the posterior aspect of the superior ramus of the pubis and is formed of periosteum and fascial condensations. The cooper ligament is an important fixation point in laparoscopic hernia repair as well as in McVay's repair[38].

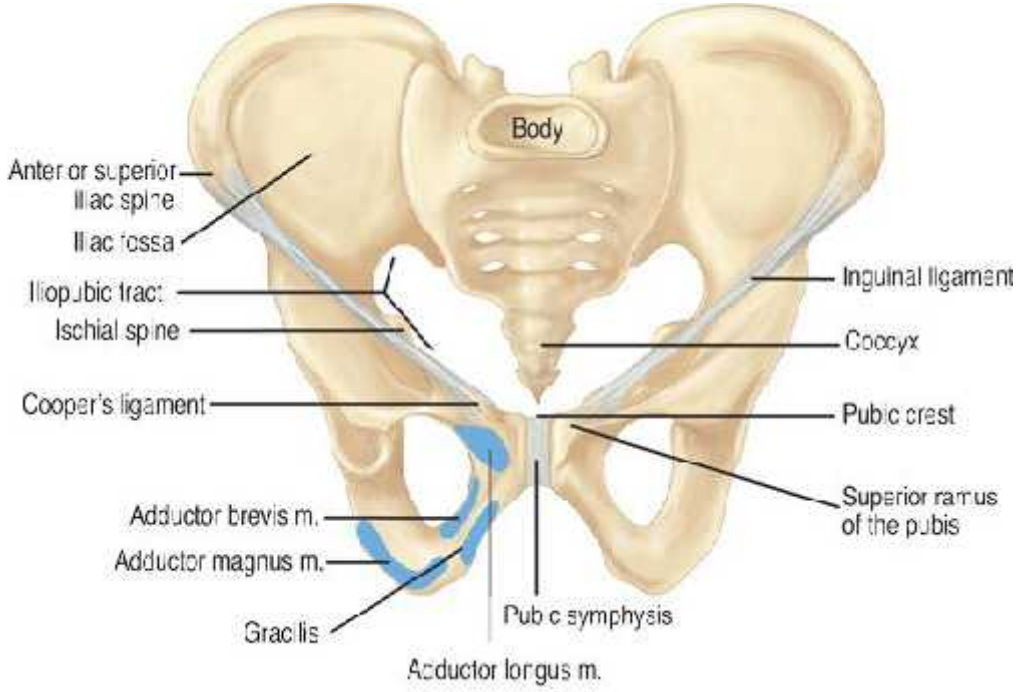


Fig 10: Ligaments in Relation to Inguinal Region

Sites of herniation[27]

Hernias of the abdominal wall occurs only in areas where aponeurosis and fascia are devoid of the protecting support of striated muscle. Without a counteracting force, the bare aponeurotic areas are subjected to ravages of intraabdominal pressure and give way if they deteriorate or contain anatomical irregularities. Predictably, the common sites of herniation are thus the groin, the umbilicus, the linea alba, the semilunar line of spieghel, the diaphragm, and surgical incisions. Other similar but rare sites of herniation are the perineum, the superior lumbar triangle of Grynfeltt, the inferior triangle of Petit and the obturator and sciatic foramina of the pelvis.

PHYSIOLOGY

Mechanism of inguinal canal

The presence of the inguinal canal is a cause of weakness in the lower part of the anterior abdominal wall. This weakness is compensated for by the following factors.

1. Flap valve mechanism

The deep and superior inguinal rings lie at opposite ends of inguinal canal and the intervening part of the canal is pressed flat when the aponeurosis are under tension and the intra abdominal pressure raised.

2. Ball valve mechanism

Contraction of the cremaster helps the spermatic cord to plug the superficial inguinal ring.

3. Slit valve mechanism

Contraction of the external oblique results in approximation of two crura of the superficial inguinal ring. The integrity of the superficial inguinal ring is greatly increased by intercrural fibres.

4. Shutter mechanism of internal oblique

This muscle has a triple relation to the inguinal canal. It forms the anterior wall, the roof and the posterior wall of the canal. When it contracts the roof is approximated to the floor, like a shutter. The arching fibres of the transversus also take part in the shutter mechanism.

5. The superficial inguinal ring is guarded from behind by the conjoint tendon and by the reflected part of the inguinal ligament.

6. The deep inguinal ring is guarded from the front by the fleshy fibres of the internal oblique.

7. Hormones may play a role in maintaining the tone of the inguinal musculature.

Whenever there is a rise in intra abdominal pressure [as in coughing, sneezing, lifting heavy weights] all these mechanisms come into play, so that the inguinal canal is obliterated, its openings are closed and herniation of abdominal viscera is prevented.

ETIOLOGY

The cause of hernia is probably multifactorial. It is assumed that 3 main factors are involved. The presence of preformed sac, repeated elevation in the intra abdominal pressure, and weakening of the body muscles and tissues with time.

Principle etiologic factors

A. Congenital

Predisposing factors for indirect inguinal hernia genesis is anatomic configuration and patent processus vaginalis. But, it is not the sole cause for hernia genesis as many persons at postmortem had patent process vaginalis without suffering from hernia during life. The descent of testis carries along with it the processes, hence predisposes to hernia. Sex wise males are common sufferers from inguinal hernia.

Subtle variants in attachment and arrangement of abdominal muscles also play a role in hernia genesis as direct hernias do not occur in females because of narrowness between inguinal ligament and transverses arch.

Congenital defects in tissue metabolism, relating to enzyme deficiency also suffer from hernia. There are deranged collagen synthesis disorders such as **Ehler's - Danlos syndrome**, where the tissues are defective. This leads to direct hernia formation. Similarly, persons with high arched lower border of transversus abdominis also develop direct hernia because of congenital posterior inguinal wall weakness.

B.Contributory factors : They are

1. Age

As age advances, abdominal muscle tissue weakness develops because of gradual tissue breakdown, hence most common in elderly persons. The reason for hernias in elderly people may be linked to findings of Rodrigues, who in 1990, reported a decrease in Oxytatum fibers and an increase in the amorphous substances of the elastic fibers as a function of age, which may be responsible for alterations in the resistance of transversalis fascia.

2.Females are particularly free of direct inguinal hernia[24,28,29]: The narrowness of the interval between the transverses arch and the inguinal ligament is an important factor protecting women against direct hernia. On the other hand, musculoaponeurotic attachments in women are such that they frequently develop femoral hernia. Other factors that are significant in the etiology are the number of aponeurotic fibers in the transversus aponeurosis, which determines the intrinsic strength of the layer.

3.Obesity

Increased fat content in the various layers of abdominal wall leads to weakness of these layers, predisposing to hernia formation.

4.Pulmonary causes

Emphysema, chronic bronchitis, pneumonitis causes laborious and difficult respiration which leads to raise in intra-abdominal pressure.

5.Genitourinary

Prostatism, constipation, diverticular disease, colonic carcinoma, all lead to straining to expel the excreta, causing raised intra-abdominal pressure. Other genitourinary problems such as cystitis, cystocele, and urethrocele play role in female to hernia formation.

6.Cardiac problems

Patients suffering from congestive heart failure will have ascites, which opens up dormant patent processus leading to hernia.

7.Pregnancy

Stretching of abdominal wall in pregnancy disrupt muscles and later replaced by collagen tissue which prevents effective action of these muscles thus predisposing to hernia.

C.Precipitating and exciting causes

1. Sudden increase in intra abdominal pressure as occurs with coughing, straining, heavy weight lifting, sneezing, crying.
2. Trauma-severe sudden blow or crush injury may lead to hernia formation.

D.Biological factors

1. **Malnutrition**

Sailors who suffer from scurvy had hernias and rupture of healed scars. This is because of vitamin 'C' deficiency which is essential for collagen synthesis. Similarly protein malnutrition are also essential for collagen synthesis and healing.

2. **Environmental toxins**

Smokers had the potentially undesirable combination of increase in proteolytic and reductions in alpha-antitrypsin, the major naturally occurring circulating protease. This combination could set the stage for the evolution of a hernia by affecting the synthesis-degradation equillibrium of groin collagen and could be a pathologic sequence initiated by excessive smoking.

E. **Iatrogenic factors : Previous operations**

1. Appendectomy may predispose to the later appearance of ipsilateral inguinal hernia. The presumptive mechanism is that damage to the innervation of the muscular constrictors of the internal ring shutter mechanism.
2. Increased intraabdominal pressure associated with chronic ambulatory peritoneal dialysis frequently results in hernia. Incidence varies from 1% to 30%.

CLASSIFICATION OF GROIN HERNIA ANATOMICAL TYPES

Indirect inguinal hernia

An indirect hernial sac is actually a dilated persistent processus vaginalis. It passes through the deep ring, lies within the spermatic cord and follows the indirect course of the cord to the scrotum.

Fig. 11 :Rt Sided Incomplete Indirect Inguinal Hernia

Direct inguinal hernia

The direct inguinal hernial sacs originate through the floor of the inguinal canal i.e., Hesselbach's triangle, they protrude directly and they are contained by the aponeurosis of the external oblique muscle.

Fig. 12: Bilateral Incomplete Direct Inguinal Hernia

Fig no.13 B/L Complete Indirect Inguinal Hernia

Fig No.14 Rt sided Complete Indirect Inguinal hernia

Fig No.15 Lt Sided Complete Indirect Inguinal Hernia

Fig No.16 Rt sided Complete Direct Inguinal Hernia

Table-1 Difference between Enterocele and Omentocele[31,32]

	ENTEROCELE	OMENTOCELE
1.	On inspection, visible peristalsis may be present	No visible peristalsis
2.	Consistency is elastic	It is doughy and granular
3.	On reduction, first part is difficult to reduce than the last part	First part goes easily but not the last part
4.	Gurgling sound – Present	Absent
5.	On percussion – Resonant	Dull note
6.	Peristaltic sounds – Present	Absent

Table-2 DIFFERENTIATION OF DIRECT AND INDIRECT INGUINAL HERNIA[30,31] :

Features	Indirect	Direct
Age	At any age, commonly infants and young adults	Usually in elderly
Sex	Mostly males, rarely females	Almost always in males
Profession	Usually no relation	More in sedentary workers
Obstruction	May be present	Usually absent
Site	Unilateral or may be bilateral	Bilateral usually
Shape	Pyriform	Globular
On coughing	Emerges obliquely	Emerges directly
On lying down	May persist or reduce gradually	Usually disappears immediately
Malgaigne's bulges	Usually absent	Usually present `
Mode of reduction	Upwards, backwards and laterally	Backwards
Internal ring occlusion test	Hernia does not reappear	Reappears
Controlled by occlusion at	Internal ring	Hesselbach's triangle
Direction of finger in invagination test	Upwards, backwards and laterally	Directly backwards
Cough impulse	Felt on tip of finger	Felt at pulp of fingers
Development	May be congenital	Acquired
Preformed sac	Present	Absent
Entrance	Internal inguinal ring	Hesselbach's triangle
Passage	Entire length of inguinal canal	Rarely medial third of canal
Exit	External inguinal ring	Very rarely external ring
Entry into scrotum	Very common	Rare
Relation of sac to cord	Within cord	Outside the cord

Types of indirect inguinal hernias

1. Vaginal

The processes vaginalis has failed to become occluded in any part of its course. The hernia therefore descends to the base of the scrotum and the testis is behind it and may be difficult to locate.

2. Funicular

The processus is obliterated above the testis. The testis can be felt separately from the hernia below it.

3. Infantile As (2), but a process of peritoneum of the processes vaginalis is found in front of the hernia as high up as the external ring. Therefore, at operation, a peritoneal sac is found in front of the hernial sac.

4. Encysted

As (1), but a process of peritoneum lies in front of the sac up to the external ring. Types (3) and (4) are due to a diverticulum of the processus vaginalis being caught up at the external ring during development.

5. Intestinal

In this type, a diverticulum of the processus vaginalis has been caught between the layers of the developing abdominal wall.

The sac may be,

- Proparietal or extraparietal (superficial) between the superficial fascia and external oblique.
- Intraparietal (intramuscular) between the internal and external oblique muscles.
- Retroparietal or intraparietal (properitoneal) between the fascia transversalis and peritoneum.This type of hernia is rare and is usually

found in association with an imperfectly descended testis[43].

Types of direct inguinal hernia

A direct hernia leaves the Hesselbach's triangle through its outer or inner part and is therefore

a. Lateral direct hernia

b. Medial direct hernia [34]

CLINICAL TYPES

1. Reducible
2. Irreducible
3. Obstructed
4. Strangulated [complication of irreducible hernia]
5. Inflamed

Reducible hernia

The hernia either reduces itself when the patient lies down, or can be reduced by the patient or the surgeon. The intestine usually gurgles on reduction and the first portion is more difficult to reduce than the last. Omentum ,in contrast, is described as doughy and the last portion is more difficult to reduce than the first. A reducible hernia imparts an expansile impulse on coughing.

Irreducible hernia

Here the contents cannot be returned to the abdomen, but there is no evidence of other complications. It is usually due to adhesions between the sac and its contents or from overcrowding within the sac.

Obstructed hernia

This is an irreducible hernia containing intestine which is obstructed from without or within, but there is no interference to the blood supply to the bowel.

The symptoms { Colicky abdominal pain and tenderness over the hernial site} are less severe and the onset more gradual than is the case in strangulation, but more often than not the obstruction culminates in strangulation.

Incarcerated hernia

This term is correctly employed only when it is considered that the lumen of that portion of the colon occupying the hernial sac is blocked with faeces.

Strangulated hernia

A hernia becomes strangulated when the blood supply of its contents is seriously impaired, rendering the contents ischaemic. Gangrene may occur as early as 5 to 6 hours after the onset of first symptoms. Although inguinal hernia may be 10 times more common than femoral hernia, a femoral hernia is more likely to strangulate because of the narrowness of the neck and its rigid surroundings.

Inflammed hernia

Inflammation can occur from inflammation of the contents of the sac { ie, acute appendicitis or salphingitis} or from external causes {Eg. the trophic ulcers which develop in the dependent areas of large umbilical or incisional hernias}. The hernia is usually tender but not tense and the overlying skin red and edematous.

NYHUS CLASSIFICATION [40]

TYPE I - Indirect inguinal hernia

Internal inguinal ring is of normal size, configuration and structure. The boundaries are well delineated and the Hesselbach triangle is normal. Eg. Paediatric hernia. There is an indirect hernial sac which extends invariably from just distal to the internal abdominal ring to the mid inguinal canal.

TYPE II - Indirect inguinal hernia

Indirect inguinal ring is dilated and distorted but posterior inguinal wall intact. Inferior deep epigastric vessels not displaced. The hernial sac is not scrotal but may occupy the entire inguinal canal.

TYPE III - Posterior wall defects

A. Direct inguinal hernia

The weakened transversalis fascia bulges outwards in front of the hernias mass. All direct hernias, small or large are type 3 A.

B. Indirect inguinal hernia

Internal inguinal ring is dilated medially, enchroaching on or destroying transversalis fascia of Hesselbach's triangle. Eg. Massive scrotal, sliding or pantaloon hernias. These sliding hernias always destroy a portion of inguinal floor.

C. Femoral hernias

A specialized form of posterior wall defect.

TYPE IV - Recurrent hernias

A. Direct

B. Indirect

C. Femoral

D. Combination[37]

GILBERT'S CLASSIFICATION[26]

TYPE I

Has a snug internal ring.

TYPE II

Has a moderately enlarged internal ring. It admits one finger but is smaller than two finger breadths. After reduction of the indirect peritoneal sac it will protrude when the patient coughs or strains.

TYPE III

Has a large internal ring, two fingerbreadths or more, as is often seen with large scrotal and sliding hernias. The reduced indirect peritoneal sac will prolapse out immediately without any effect on the part of the patient.

TYPE IV

This is a typical direct hernia characterised by a large or full blow out of the posterior wall of the canal. The internal ring is intact.

TYPE V

This is a direct hernia protruding through a punched out hole in the transversalis fascia. The internal ring is intact. Robbins and Rutkow added two more to Gilberts classification.

TYPE VI - Double or Pantaloon hernia

TYPE VII - Femoral hernia

COMPOSITION OF A HERNIA [34,35]

As a rule, a hernia consists of three parts, the sac, the coverings of the sac and the contents of sac.

The sac

The sac is a diverticulum of peritoneum consisting of mouth, neck, body and fundus. The neck is usually well defined, but in some direct inguinal hernias and in many incisional hernias there is no actual neck. The diameter of the neck is important because strangulation of the bowel is a likely complication where the neck is narrow, as in femoral and paraumbilical hernias.

The body of the sac

The body of the sac varies greatly in size and is not necessarily occupied. In cases occurring in infancy and childhood the sac is gossamer thin. In long standing cases the wall of the sac may be comparatively thick.

The covering

Coverings are derived from the layers of the abdominal wall through which the sac passes. In long standing cases they become atrophied from stretching and so amalgamated that they are indistinguishable from each other.

In indirect inguinal hernia [36] ,

a) Extraperitoneal tissue

b) Internal spermatic fascia, derived from fascia transeversalis.

c) Cremasteric fascia, derived from internal oblique and transeversus abdominus.

d) External spermatic fascia, derived from external oblique aponeurosis.

e) Skin

In lateral direct hernia [36]

Same as for indirect hernia except that instead of internal spermatic fascia there is fascia transversalis (of the posterior wall of the inguinal canal).

In medial direct hernia[36]

a) Extraperitoneal tissue

b) Fascia transversalis

c) Conjoint tendon

d) External spermatic fascia

e) Skin

CONTENTS [34]

These can be

- Omentum- Omentocele (syn. Epiplocele)
- Intestine- Enterocele. More commonly small bowel, but may be large intestine or appendix.
- A portion of the circumference of intestine- Richter's hernia.
- A portion of the bladder {or a diverticulum} may constitute part of or be the sole contents of a direct inguinal, a sliding inguinal or a femoral hernia.
- Ovary with or without corresponding fallopian tube.
- A Meckel's diverticulum- a Littre's hernia.
- Fluid, as part of ascites or as a residuam there of.

CLINICAL FEATURES

"Clinical diagnosis is an art and mastery of an art has no end you can always be a better diagnostician".[38]

L.Clendening (1884-1943)40,47,48,49

HISTORY [34,41,42,43]

Age

Inguinal hernia occur at all ages. The peak times of presentation are in the first few months of life, in the late teens, and early 20s, and between 40 and 60 years.

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.

Local Symptoms

The commonest symptoms are discomfort and pain. The patient complains of a dragging, aching sensation in the groin, which gets worse as the day passes.

On the other hand, many hernias cause no pain and the patient presents because he has noticed a swelling in the groin or in the scrotum. He may have noticed that it gets smaller when he lies down and that he can push it away. The patient may complain of lumps on both sides.

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.

1. Colicky abdominal pain.
2. Vomiting.
3. Abdominal distention and
4. Absolute constipation.

Examination

The principal features to be determined are the size, site and constituents of the lump together with the two diagnostic signs- reducibility and an expansile cough impulse.

Position

All inguinal herniae can be seen as a visible lump when they appear through the superficial ring. This ring is just above the crest of the pubic bone and the pubic tubercle.

Once the hernia has passed through the ring, it may descend to the scrotum. Thus, as it descends into the scrotum, it is often not medial to the pubic tubercle. The oft-quoted description, above and medial to the pubic tubercle refers to the point at which the hernia reduces into the abdominal wall (i.e., the external inguinal ring) not to the position of the whole hernia.

Colour

The skin overlying an inguinal hernia should be normal. If the hernia is strangulated, the skin may be a little reddened.

Temperature

The temperature of the skin overlying a hernia should be the same as the surrounding skin except when the hernia is strangulated or infected, when it becomes hot.

Tenderness

Hernia may contain any viscus and as all abdominal structures have a visceral sensory innervation, manual pressure in usually uncomfortable but rarely very painful. By contrast a strangulated hernia is very tender.

Shape

Most inguinal hernia resemble a large pear with the 'stalk' at the external inguinal ring. Some also cause a bulge along the line of the inguinal canal, with a narrowing at the external inguinal ring, giving them an hourglass appearance.

Size

Inguinal hernia vary from very small bulges, 1-2 cm in diameter to larger masses which extend down to the knee joint.

Surface

The surface will vary according to the nature of the contents but is usually smooth and sometimes bosselated.

Composition

Hernia that contains gut should be soft, resonant, and fluctuant, and may have bowel sounds. A large scrotal hernia containing small intestine may show visible peristalsis.

Many hernia contains omentum, this makes the feel doughy & granular, non-fluctuant, and dull to percussion.

Expansile cough impulse

A hernia should become larger and more tense during coughing { i.e. expansile cough impulse }

Compressibility

A hernia can be compressed by steady pressure and will not recur immediately, when the compression is released, unless some force such as gravity, or coughing, forces it out.

Reducibility

The diagnostic sign of hernia is reducibility. This implies that it is possible to return the contents of the hernia to their normal anatomical site- the abdomen.

State of local tissues

As acquired inguinal hernia are caused by weakness of the tissue to the inguinal canal, bulging of both inguinal regions with coughing is common. Minor bilateral bulging of the inguinal canal is normal and known as Malgaigne's bulges.

General examination

One should look for the common causes of a raised intra-abdominal pressure-chronic bronchitis and coughing, chronic retention of urine, difficulty in micturition, ascites, intra-abdominal masses and chronic constipation. Look for any signs of intestinal obstruction/distension, increased bowel sounds, visible peristalsis[47].

DIFFERENTIAL DIAGNOSIS [41]

Inguinoscrotal swellings

1. Encysted hydrocele of the cord.
2. Varicocele
3. Lymph varix or lymphangiectasis
4. Funiculitis
5. Diffuse lipoma of the cord
6. Inflammatory thickening of the cord

7. Malignant extension of the testis
8. Torsion of the testis
9. Retractile testis

Groin swellings

1. Femoral hernia
2. Saphena varix
3. Enlarged lymph nodes
4. Psoas abscess
5. Enlarged psoas bursa
6. Undescended and ectopic testis
7. Lipoma
8. Hydrocele of femoral hernial sac
9. Femoral aneurysm

INCIDENCE [45]

1) In the world scenario : According to epidemiological data available on the website bestpractice.bmj.com/best-practice/monograph/723/basics/epidemiology.html, inguinal hernia incidence is 0.14% of the overall population. The specific hernia incidence varies between countries, but range from 100-300 primary inguinal hernias per 100,000 people per year.
2) In the Indian scenario: According to study conducted by Asia Pacific Hernia Society, incidence of primary inguinal hernia is 1,957,850 cases in 1,065,070,607 estimated population used. This accounts for 0.18% {www.aphernia.com/herniastatistics.htm}.
3) In our hospital BLDEU's Shri B.M.Patil Medical Colllege Hospital and Research Centre Bijapur, the incidence of primary inguinal hernia is about 0.18%

Statistics by Country for Inguinal hernia

Table 3

Country/Region	Extrapolated Incidence	Population Estimated Used
Inguinal hernia in Northern Asia (Extrapolated Statistics)		
Mongolia	5,057	2,751,314[2]
Inguinal hernia in Central Asia (Extrapolated Statistics)		
Kazakhstan	27,837	15,143,704[2]
Tajikistan	12,888	7,011,556 [2]
Uzbekistan	48,548	26,410,416[2]
Inguinal hernia in Eastern Asia (Extrapolated Statistics)		
China	2,387,587	1,298,847,624[2]
Hong Kong s.a.r.	12,601	6,855,125[2]
Japan	234,068	127,333,002[2]
Macau s.a.r.	818	445,286[2]
North Korea	41,723	22,697,553[2]
South Korea	88,664	48,233,760[2]
Taiwan	41,819	22,749,838[2]
Inguinal hernia in Southwestern Asia (Extrapolated Statistics)		
Turkey	126,643	68,893,918[2]
Inguinal hernia in Southern Asia (Extrapolated Statistics)		
Afghanistan	52,414	28,513,677[2]
Bangladesh	259,817	141,340,476[2]
Bhutan	4,017	2,185,569[2]
India	1,957,850	1,065,070,607[2]
Pakistan	292,640	159,196,336[2]
Sri Lanka	36,590	19,905,165[2]
Inguinal hernia in Southeastern Asia (Extrapolated Statistics)		
East Timor	1,873	1,019,252[2]
Indonesia	438,332	238,452,952[2]
Laos	11,154	6,068,117[2]
Malaysia	43,239	23,522,482[2]
Philippines	158,532	86,241,697[2]
Singapore	8,003	4,353,893[2]
Thailand	119,238	64,865,523[2]
Vietnam	151,953	82,662,800[2]
Inguinal hernia in the Middle East (Extrapolated Statistics)		
Gaza strip	2,435	1,324,991[2]
Iran	124,086	67,503,205[2]

Iraq	46,644	25,374,691[2]
Israel	11,395	6,199,008[2]
Jordan	10,314	5,611,202[2]
Kuwait	4,149	2,257,549[2]
Lebanon	6,943	3,777,218[2]
Saudi Arabia	47,419	25,795,938[2]
Syria	33,119	18,016,874[2]
United Arab Emirates	4,639	2,523,915[2]
West Bank	4,248	2,311,204[2]
Yemen	36,810	20,024,867[2]
Inguinal hernia in Oceania (Extrapolated Statistics)		
Australia	36,605	19,913,144[2]
New Zealand	7,341	3,993,817[2]
Papua New Guinea	9,963	5,420,280[2]
Inguinal hernia in North America (Extrapolated Statistics)		
USA	539,807	293,655,405[1]
Canada	59,757	32,507,874[2]
Mexico	192,940	104,959,594[2]
Inguinal hernia in Central America (Extrapolated Statistics)		
Belize	501	272,945[2]
Guatemala	26,251	14,280,596[2]
Nicaragua	9,852	5,359,759[2]
Inguinal hernia in Caribbean (Extrapolated Statistics)		
Puerto Rico	7,165	3,897,960[2]
Inguinal hernia in South America (Extrapolated Statistics)		
Brazil	338,421	184,101,109[2]
Chile	29,088	15,823,957[2]
Colombia	77,777	42,310,775[2]
Paraguay	11,381	6,191,368[2]
Peru	50,632	27,544,305[2]
Venezuela	45,987	25,017,387[2]
Inguinal hernia in Northern Europe (Extrapolated Statistics)		
Denmark	9,951	5,413,392[2]
Finland	9,585	5,214,512[2]
Iceland	540	293,966[2]
Sweden	16,519	8,986,400[2]
Inguinal hernia in Western Europe (Extrapolated Statistics)		
Britain (United Kingdom)	110,791	60,270,708 for UK[2]
Belgium	19,022	10,348,276[2]
France	111,073	60,424,213[2]
Ireland	7,296	3,969,558[2]

Luxembourg	850	462,690[2]
Monaco	59	32,270[2]
Netherlands (Holland)	29,996	16,318,199[2]
United Kingdom	110,791	60,270,708[2]
Wales	5,363	2,918,000[2]
Inguinal hernia in Central Europe (Extrapolated Statistics)		
Austria	15,027	8,174,762[2]
Czech Republic	2,290	1,0246,178[2]
Germany	151,515	82,424,609[2]
Hungary	18,441	10,032,375[2]
Liechtenstein	61	33,436[2]
Poland	71,004	38,626,349[2]
Slovakia	9,969	5,423,567[2]
Slovenia	3,697	2,011,473 [2]
Switzerland	13,696	7,450,867[2]
Inguinal hernia in Eastern Europe (Extrapolated Statistics)		
Belarus	18,953	10,310,520[2]
Estonia	2,466	1,341,664[2]
Latvia	4,239	2,306,306[2]
Lithuania	6,632	3,607,899[2]
Russia	264,658	143,974,059[2]
Ukraine	87,742	47,732,079[2]
Inguinal hernia in the Southwestern Europe (Extrapolated Statistics)		
Azerbaijan	14,463	7,868,385[2]
Portugal	19,345	10,524,145[2]
Spain	74,045	40,280,780[2]
Georgia	8,628	4,693,892[2]
Inguinal hernia in the Southern Europe (Extrapolated Statistics)		
Italy	106,723	58,057,477[2]
Greece	19,572	10,647,529[2]
Inguinal hernia in Northern Africa (Extrapolated Statistics)		
Egypt	139,921	76,117,421[2]
Libya	10,352	5,631,585[2]
Sudan	71,963	39,148,162[2]
Inguinal hernia in Western Africa (Extrapolated Statistics)		
Congo Brazzaville	5,511	2,998,040[2]
Ghana	38,156	20,757,032[2]
Liberia	6,232	3,390,635[2]
Niger	20,883	11,360,538[2]
Nigeria	32,629	12,5750,356[2]
Senegal	19,948	10,852,147[2]
Sierra leone	10,815	5,883,889[2]

Inguinal hernia in Central Africa (Extrapolated Statistics)		
Central African Republic	6,879	3,742,482[2]
Chad	17,534	9,538,544[2]
Congo kinshasa	107,200	58,317,030[2]
Rwanda	15,144	8,238,673[2]
Inguinal hernia in Eastern Africa (Extrapolated Statistics)		
Ethiopia	131,133	71,336,571[2]
Kenya	60,628	32,982,109[2]
Somalia	15,265	8,304,601[2]
Tanzania	66,306	36,070,799[2]
Uganda	48,511	26,390,258[2]
Inguinal hernia in Southern Africa (Extrapolated Statistics)		
Angola	20,181	10,978,552[2]
Botswana	3,013	1,639,231[2]
South Africa	81,706	44,448,470[2]
Swaziland	2,149	1,169,241[2]
Zambia	20,267	11,025,690[2]
Zimbabwe	6,749	1,2671,860[2]

OPERATIVE PROCEDURES

Position of the patient

The patient is placed on his back on the operating table. Access is improved if the head of the table is tilted downwards by about 15 .

Incision

The classic incision is made 2.5 cm above and parallel to the medial three-fifths of the inguinal ligament, but a more horizontally placed skin-crease incision will produce a more acceptable scar. Laterally the incision begins over the deep inguinal ring, runs to the pubic tubercle, then curves caudally (vertically) and rundown over the pubic tubercle.

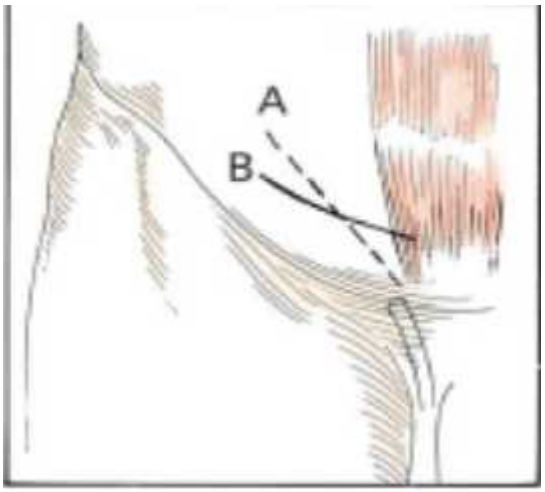


Fig 17: Skin Incision[46,47,48]

Exposure

After the skin has been divided the subcutaneous fat is opened in the length of the incision down to the external oblique aponeurosis. The superficial pudendal and superficial epigastric vessels are dealt with cautery. The deep fascia of the thigh is opened to allow access to the femoral canal exposed below the inguinal ligament and checked to make sure it is intact.

Dissection throughout the operation must be meticulous and careful haemostasis must be observed to avoid haematomas and infection.

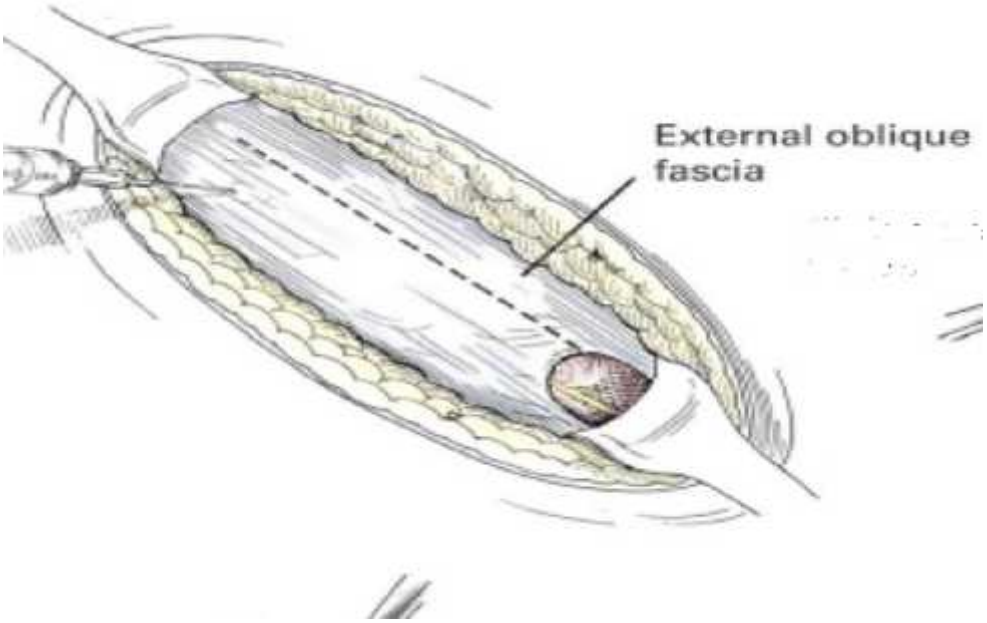


Fig 18: Incision of External Oblique Fascia

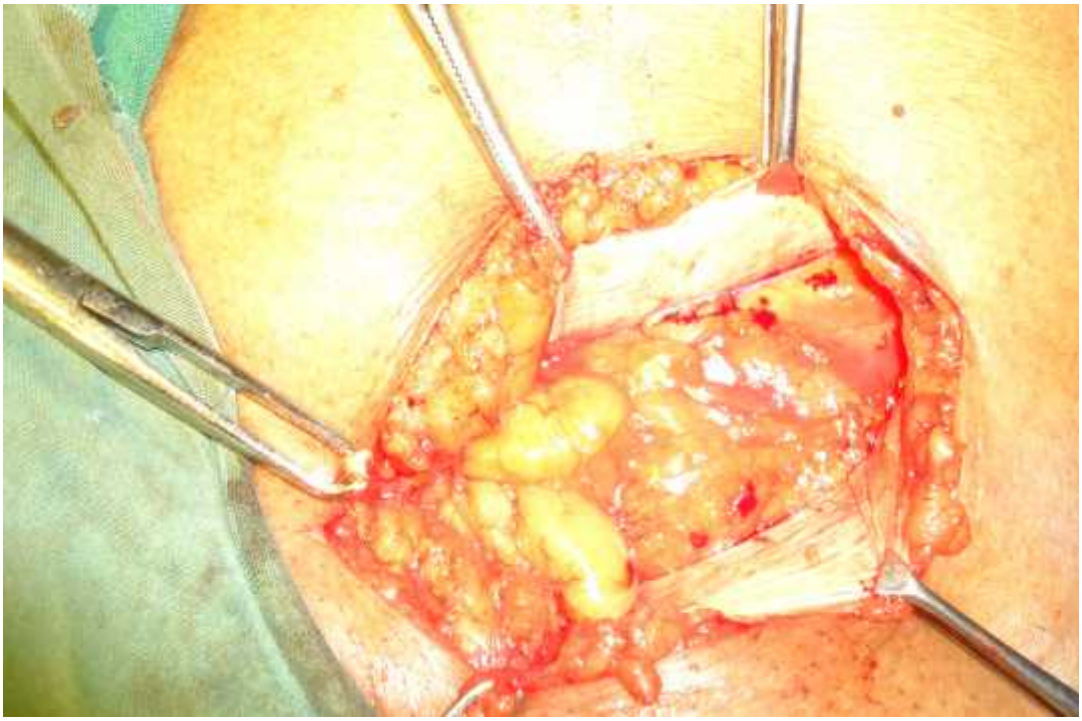


Fig. 19 : After Opening External Oblique Aponeurosis

Dissection of the canal

The external oblique aponeurosis is next opened in the long axis of the inguinal canal. This incision extends down to the external inguinal ring, the margin of which is divided. The condensation of the transversalis fascia about the emerging cord is the deep ring and it must be identified accurately.

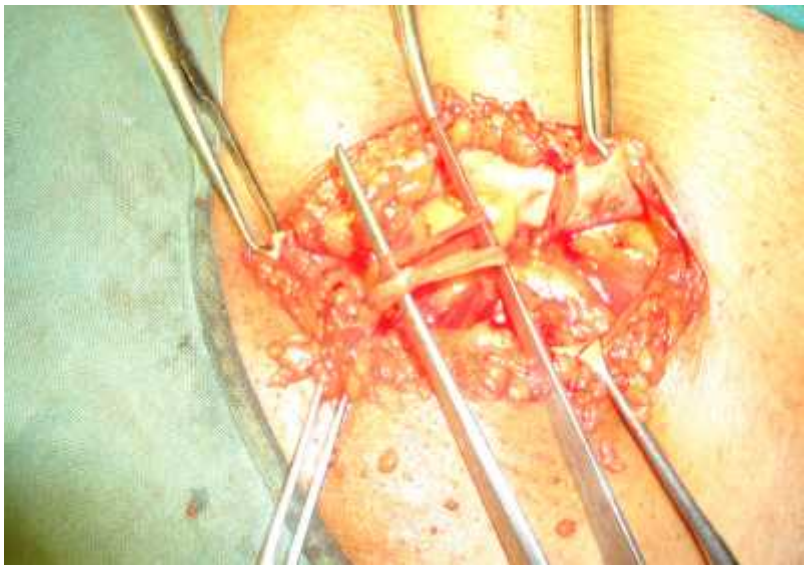


Fig 20. Identifying and Preserving Ilioinguinal Nerve

Forceps are applied to the two cut edges, the upper leaf is retracted to expose the conjoined muscles arching over the cord and the lower to expose the upper surface of the inguinal ligament. The ilioinguinal and iliohypogastric nerves are identified and safeguarded.

The cord, with which is included the hernial sac is lifted up from the medial part of the incision and is spread out on the finger. Its coverings are incised longitudinally and are further separated by blunt dissection, care being taken to avoid injuring the spermatic veins. The sac appears as a pearly white structure lying on the anterosuperior aspect of the cord structures. The sac is separated by gauze stripping. As the separation proceeds traction is applied to the sac and the stripping is continued until the neck comes into view. This is identified from the presence of an adherent pad or collar of fat. The inferior epigastric vessels lie to the medial side of indirect and lateral to direct hernia and care should be taken that they are not injured. When separation is complete the sac is opened at some distance from its neck and a finger is introduced into its interior to ensure that it is empty of its contents. Adherent contents are freed from the sac and returned to the abdomen.

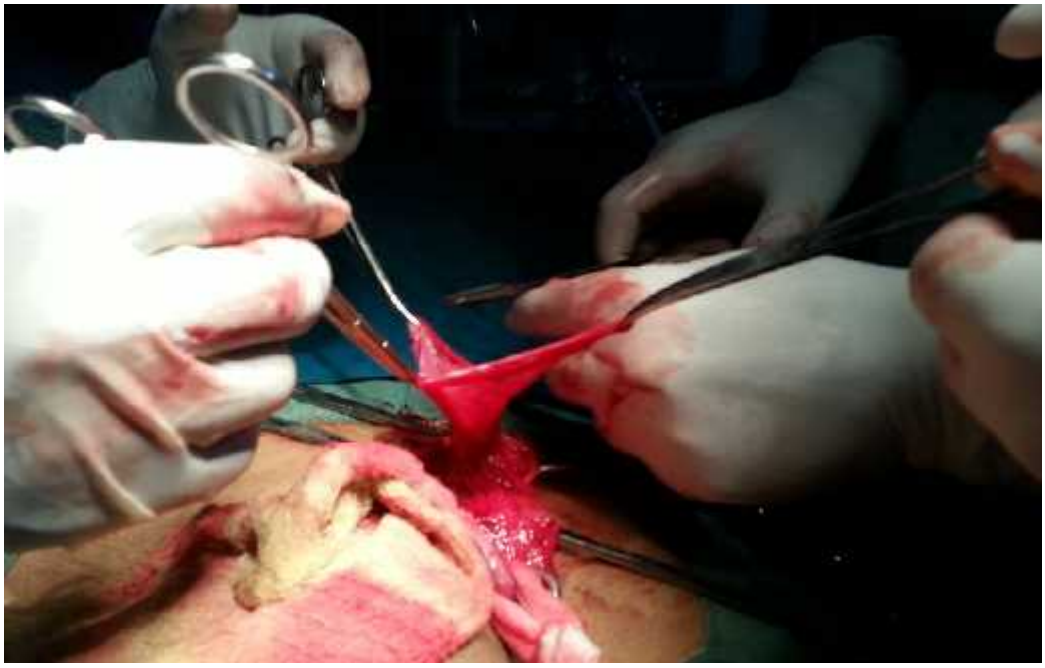


Fig. 21 : Opened Indirect Hernial Sac

If there is any doubt about the omentum it is best excised, because to return omentum of doubtful viability to the peritoneal cavity invites the formation of adhesion.

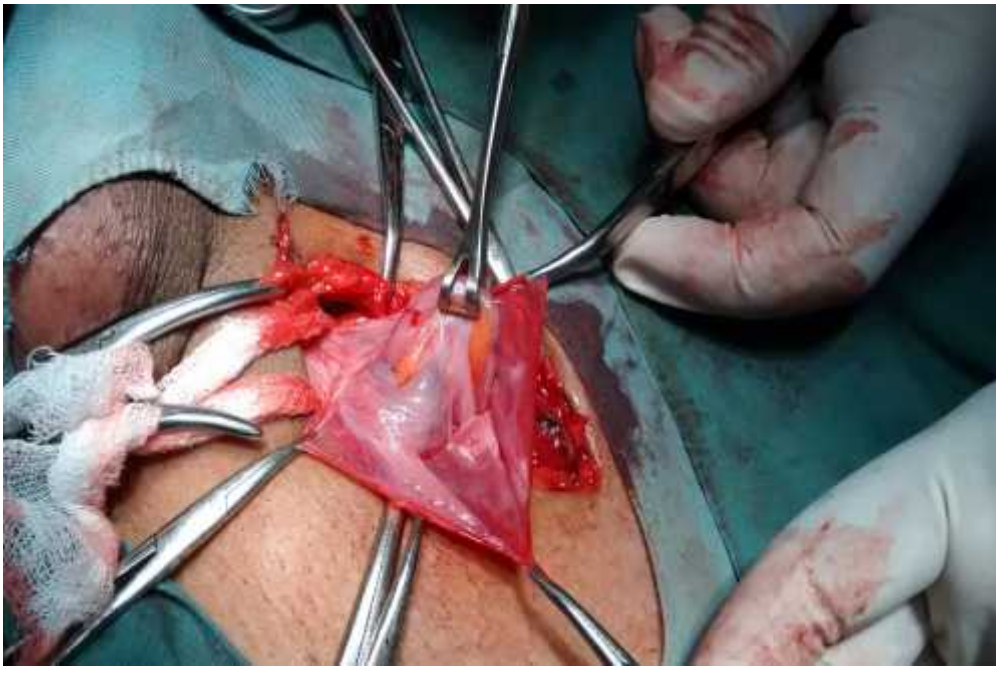


Fig. 22: Content of the Indirect Hernial Sac

In the case of scrotal hernia, where the fundus of the sac may not come easily into view, there is no objection to leaving the distal part of the sac in situ. This obviates the dissection required to

deliver the sac from the depth of the scrotum and greatly reduces the risk of subsequent testicular atrophy and haematoma formation.

The sac is now drawn strongly downwards and is twisted at its neck in order to occlude it before the ligature is applied. The sac is amputated 1cm below the ligature prior to cutting the ligature so that there is adequate control of the stump in the event of bleeding. If the ligature has been applied at a sufficiently high level the stump will immediately retract well above the deep inguinal ring to lie flush with the general peritoneum.

Fig. 23 : Transfixation of the Sac

RECONSTRUCTIVE PROCEDURES

The Lichtenstein Tension-free repair

Since the early 1980s, the surgical techniques used in repairing groin hernias has undergone a profound transformation. These changes are highlighted by the fact that in 1996 over 50% of all groin hernia repairs incorporated a mesh prosthesis as part of the repair. In the tension-free repair the mesh prosthesis is not utilized to buttress or support a primarily sutured herniorraphy[53], but is the actual repair [44].

After reducing the sac, a sheet of polypropylene mesh measuring approximately 6x11 cms is trimmed to fit the area exposed and used to reconstruct the entire floor of the inguinal canal without any attempt to close the defect by suture. The mesh is sutured along its lower edge to the pubic tubercle, the lacunar ligament and the inguinal ligament to beyond the internal ring with a continuous 3-0 polypropelene suture. The superior edge is tacked down to the aponeurosis or muscle of the internal oblique with a few interrupted sutures. The lateral edge of the mesh is slit and the two tails passed around to embrace the cord at the internal ring, they then are crossed over each other and tacked down to the inguinal ligament with one polypropelene suture. This creates a new internal ring and shutter mechanism. The external oblique aponeurosis is then sutured in front of the cord. This is a completely tensionless repair and requires no formal reconstruction of the canal floor; it is a revolutionary departure from the tissue repairs used for the past 100yrs since Bassini [26] .

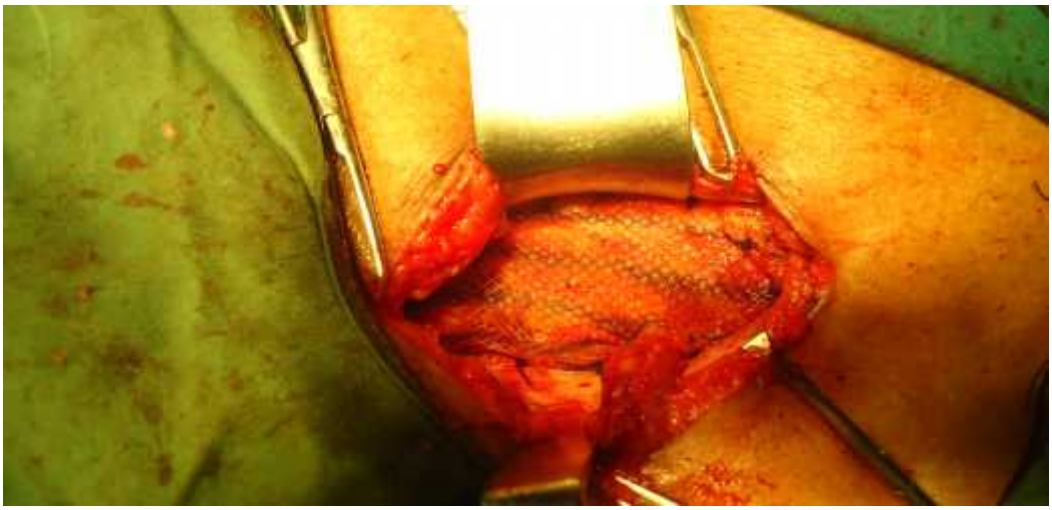


Fig. 24 a : The Lichtenstein Repair Closure with Lightweight Mesh

Fig. 24 b : The Lichtenstein Repair Closure with Lightweight Mesh

Fig. 24 c : The Lichtenstein Repair Closure with Lightweight Mesh

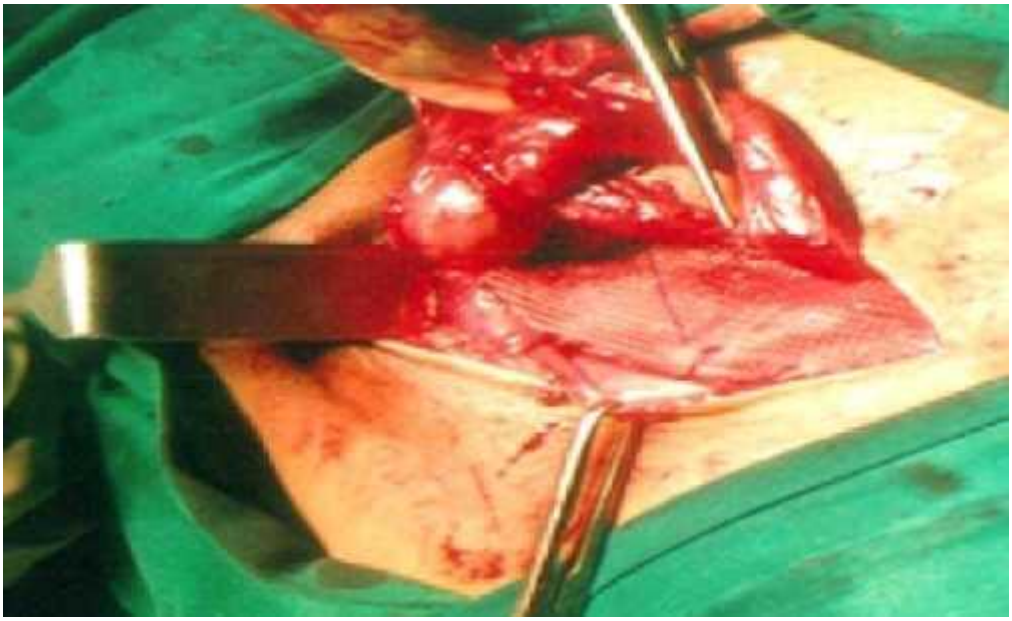


Fig No.24 d The Lichtenstein Repair Closure with Standard Prolene Mesh

Cord structures are placed over the repaired posterior wall. The external oblique aponeurosis is reapproximated either by simple suture or preferably by overlapping, The reconstituted superficial ring should fit snugly around the cord, but it must not be too tight or atrophy of the testis may result; it should admit the tip of the little finger without difficulty in addition to the cord. After careful haemostasis the wound is closed by suturing of the superficial fascia and skin.

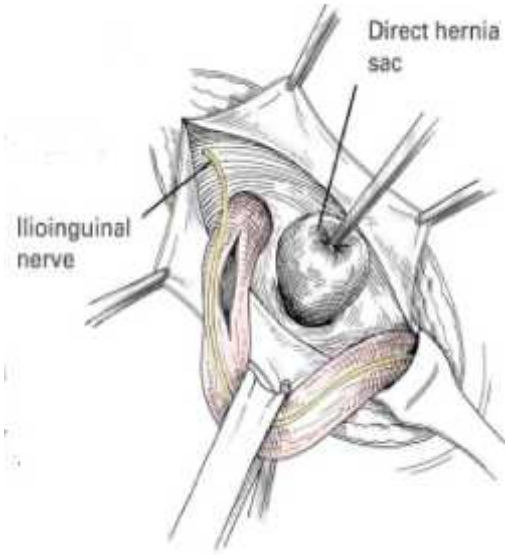


Fig 25: Identification of Direct Sac

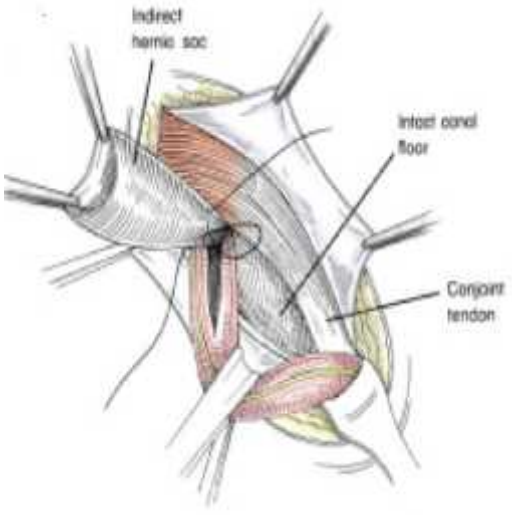


Fig 26: Identification of Indirect Sac and Its High Ligation.

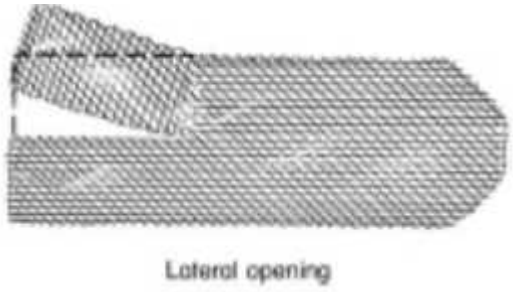


Fig 27: Lateral Incision of Mesh

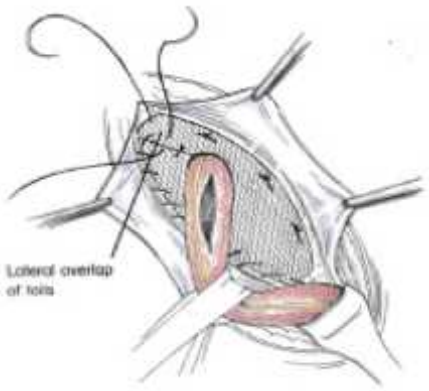


Fig 28: Placement and Fixing of Mesh

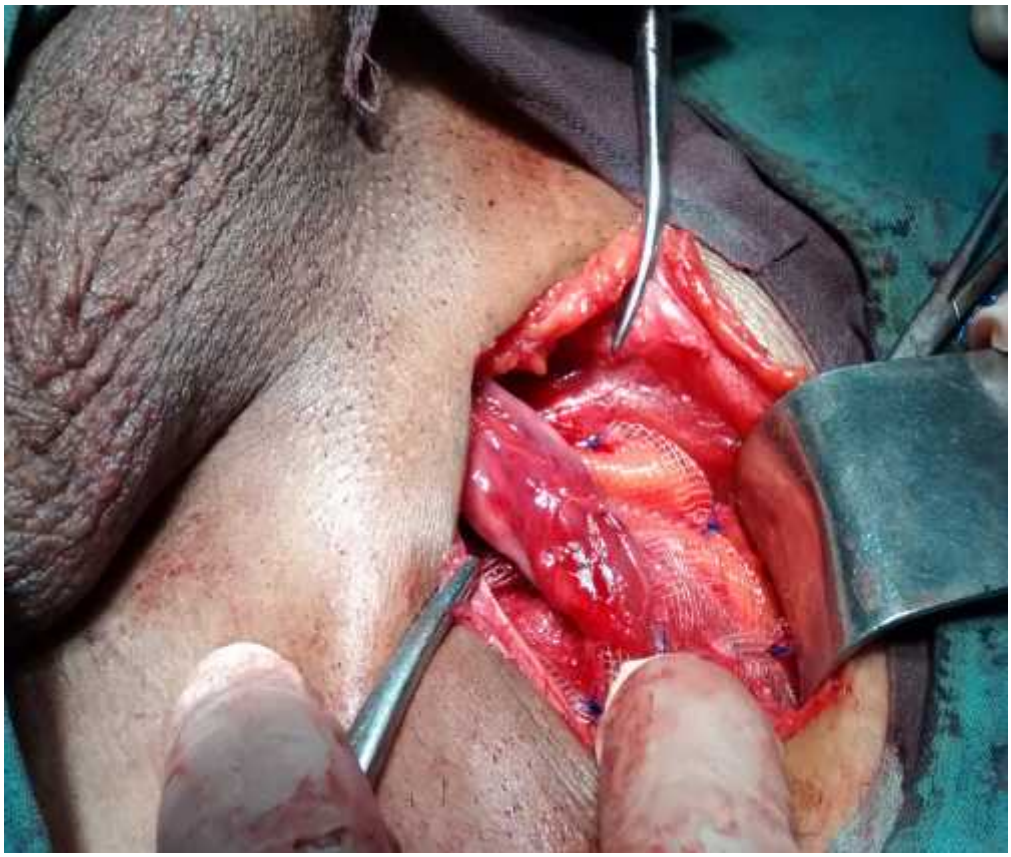


Fig 28 a: Plcement and Fixing of Mesh

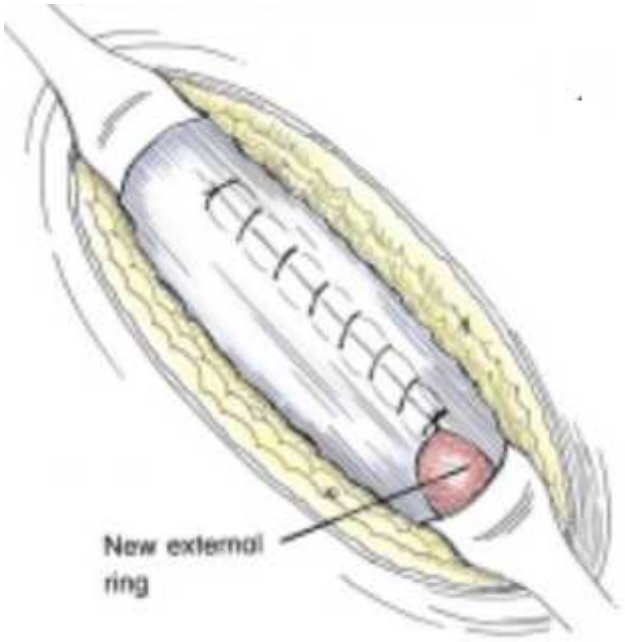


Fig 29: Closure of External Oblique

Fig.30 Skin Closure

Fig 30a. Skin Closure

Fig No.31 After Suture Removal

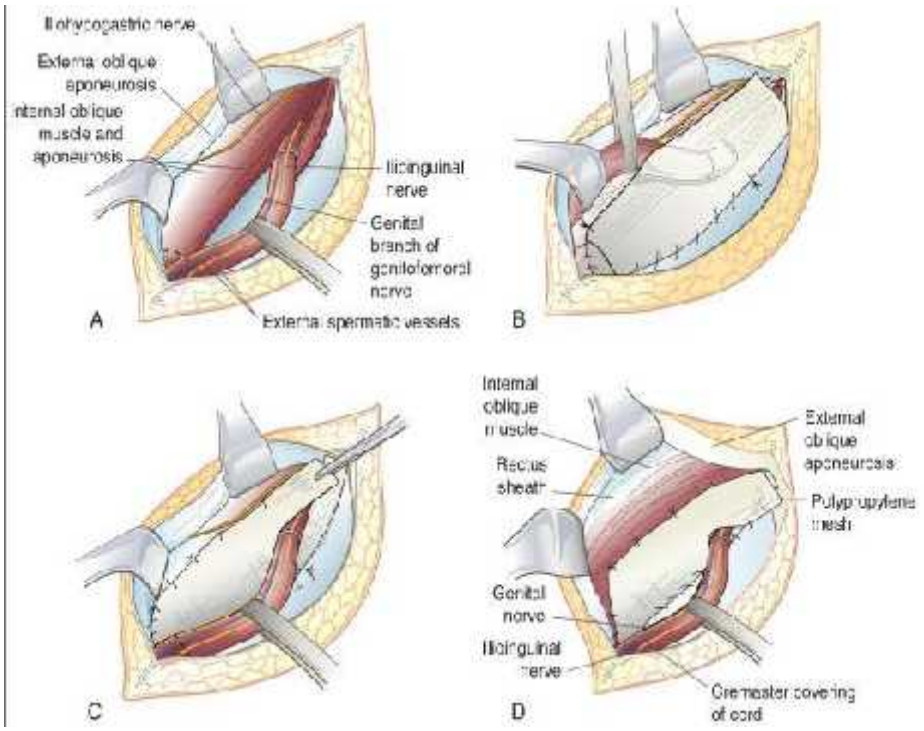


FIGURE 32: SCHEMATIC DIAGRAM OF LICHTENSTEIN'S TENSION FREE HERNIOPLASTY

MESH IN HERNIA REPAIR

The term "mesh" refers to prosthetic material, either a net or a flat sheet which is used to strengthen a hernia repair[49]. Mesh can be used:

- To bridge a defect: Tension free patch
- To plug a defect: Plug of mesh is pushed into the defect
- To augment a repair: Defect closed with sutures and mesh used to reinforce[49].

A well placed mesh should have good overlap around all margins of the defect, at least 2 cm but up to 5 cm if possible.

HISTORICAL PERSPECTIVE AND CURRENT LITERATURE

HISTORY OF SURGICAL MESHES[64,65]

Father of modern herniorraphy, Edardo Bassini did his first herniorraphy in 1884.

Shouldice devised a multilayer technique of inguinal repair in1952.

Billroth quotes "**if we could artificially produce tissues of the density and toughness of fascia and tendon, the secret of radical cure of hernia would be discovered."**

Numerous materials were tried but they fell victim to the triple headed monster of Infection ,

Rejection,

Recurrence

Historically , the use of prosthesis to reinforce the posterior wall of the inguinal canal was first reported by McGavin in 1909 at the Greenwick Siamens hospital London who used silver filigree. Unfotunately, the filigree suffered stress fracture over the years and the successful application of prosthetic mesh had to await the introduction of an inert indestructible material such as polypropylene by Usher.

When Francis Usher introduced Marlex mesh in1962 for technically challenging cases, a new era began during which this prosthesis when used in uncontaminated groin hernias , began to overcome the then current objections to mesh. However Usher was not in favour of using mesh for simple hernias.

In 1986, the tension free inguinal hernia repair with mesh was described by Lichtenstein. Lichtenstein repair has become the most popular open technique for

inguinal hernia repair and has been shown to have superior recurrence rates, simplicity of repair, and the decreased post operative pain when compared with tissue based hernia repair.

He advocated this technique for all groin hernias large or small, complex or straight forward and maintained that essential components included local anesthesia, immediate ambulation and same day discharge, each contributing to the overall success.

The long term results of the Lichtenstein technique have been reported over the last 10 yrs and in several recent series of over 10,000 cases, have shown recurrence rates of 0.2% and the infection rate of 0.03%.

The body generates an intense inflammatory response to the prosthetic that results in scar plate formation, increased stiffness of the abdominal wall, and shrinkage of the biomaterial.

The trend changed in the early and mid 1990's in parallel with increasing number of case reports reporting mesh related complications after heavy mesh based hernia repair such as seromas, discomfort ,decreased abdominal wall mobility which are frequently observed post mesh hernioplasty. Serious complications such as recurrence chronic and persisting pain as well as infection , including fistula formation are rare.

Reducing the density of polypropylene and creating a "lightweight" mesh theoretically induces less foreign body response, results in improved abdominal wall compliance ,causes less contraction or shrinkage of the mesh, and allows for better tissue incorporation.

Some of the lightweight meshes being used are Vypro {polypropylene with PG910; 25g/m^2 }, Vypro II {polypropylene with PG910;30g/m^2 } and Ultrapro {polypropylene with polyglecaprone;28g/m^2 }.

PROPERTIES OF IDEAL PROSTHETIC MATERIAL [54,55] :

In 1950's Cumberland and Scales developed 8 still pertinent criteria for ideal implantable biomaterial. They have been enumerated more recently by Homes – Hodges and Scott.

PROPERTIES OF IDEAL PROSTHETIC MATERIAL[66,67,68,69]

- Be chemically inert
- Be non-carcinogenic
- Not to be physically modified by tissue fluids
- Not to produce allergy or hypersensitivity
- Be capable of resisting mechanical strain
- Be easily producible and stable
- Be sterilizable
- Be permeable and allow tissue ingrowth within it
- Should stimulate fibroblastic activity to allow incorporation into tissue
- Be sufficiently pliable

Future biomaterials must meet 3 additional criteria to more nearly match the above requirements for an ideal prosthetic material :

- They must be resistant to infection
- They must provide better barrier to adhesions on the side of the material placed adjacent to the abdominal viscera, and
- They must respond in vivo more like autologous tissue allowing tissue incorporation for good fixation and a strong lasting repair without encouraging scarring and encapsulation problems seen with many of today's prosthesis.

MESH TYPES

A wide array of meshes available can be classified based on:

GROSS STRUCTURE [49]:

Net meshes: allow fibrous tissue ingrowth and become integrated into host tissue

Woven

Knitted

Flat sheets: Do not allow fibrous tissue ingrowth but become encapsulated by fibrous tissue.

BASED ON

WEIGHT [50]

1. Ultra-light <35 g/m2
2. Light 35-70 g/m2
3. Standard 70-140 g/m2
4. Heavy >140 g/m2

Heavy weight meshes provoke greater tissue reaction leading to collagen contraction and stiffening causing pain and shrinkage of mesh. Light weight meshes are preferred as they have better tissue integration, less shrinkage, more flexibility and improved comfort[49].

BASED ON BIOMATERIAL:

SYNTHETIC NON ABSORBABLE:

Polypropylene: strong monofilament mesh, dos not have any antibacterial property but its hydrophobic nature and monofilament structure impede bacterial ingrowth[49].

Polyester: braided filament mesh, because of its hydrophilic nature may allow infection to hold[49].

Polytetrafluoroethylene: Flat sheets, as a result do not allow any tissue ingrowth hence used as a non-adhesive barrier between tissue layers, however wound complications (ie, infection, sinuses and fistulisation) deterred its use. In 1963 a process for expanding PTFE was discovered in japan, which resulted in a strong porous material, subsequently 1-2 mm sheets were prepared for use in field of herniology.

SYNTHETIC ABSORBABLE: As it is absorbed before adequate tissue reaction its use is not recommended for permanent repair of groin hernias, but may be satisfactory for use in contaminated wounds, temporary repair of hernias or for buttress of tissue repair[51].

- Polyglycolic acid mesh
- Polydiaxanone
- Polyglactin mesh

COATED ABSORBABLE: Nonabsorbable mesh is coated with absorbable compound like omega-3fatty acid, complex carbohydrate etc. Attenuates host response to prosthesis thus advantageous in situations where mesh is exposed to viscera as in TAPP.

Glucomesh: Polypropylene mesh coated with absorbable complex carbohydrate.

C-Qur Mesh: Polypropylene mesh coated with absorbable omega-3fatty acid.

TISSUE SPARING MESHES {Dual meshes}: Can be used intra-peritoneally. Parietal side of the mesh is sticky aiding adherence and host tissue in growth, visceral side (coated with polycellulose, collagen, PTFE) is slippery to prevent adhesions to bowel[49].

BIOLOGIC: Sheets of sterilized, decellularised, non-immunogenic connective tissue. They provide a scaffold to encourage neovascular in growth and new collagen deposition. They are expensive and associated with increased risk of recurrence[49].

BASED ON PORE SIZE [52]

Type I: Totally macroporous prostheses, pore size >75 microns. Eg. Polypropylene

Type II: Totally microporous prostheses, pore size <10 microns in one of their three dimensions. Eg. PTFE

Type III: Macroporous prosthesis with multifilamentous or microporous components. Eg. Braided polypropylene mesh.

Type IV: Biomaterials with submicronic pore size, not suitable or hernia repair.

HOW DOES PROSTHETIC MATERIAL WORK[68,70]

- After any prosthetic is implanted , an extraordinarily complex series of events takes place immediately after implantation.
- The prosthetic adsorbs proteins that create a coagulum around it. This coagulum consists of albumin, plasminogen, fibrinogen, immunoglobulins and complement factors.
- Platelets adhere to this protein coagulum and release a host of chemo attractants that invite other platelets, smooth muscle cells, polymorphonucleocytes{PMN's}, fibroblasts and macrophages to the area in a variety of sequences.
- Activated PMN's drawn to the area release proteases to attempt to destroy the foreign body in addition to organisms surrounding tissue. PMN's also further attract macrophages, smooth muscle cells, and fibroblasts.
- Macrophages then increasingly populate the area to consume foreign bodies as well as dead organisms and tissue. These cells ultimately coalesce into foreign body giant cells that stay in the area for an indefinite period of time, their role being unclear.

— The fibroblasts and smooth muscle cells subsequently secrete monomeric fibres that polymerize into the helical structure of collagen deposited in the extracellular space.

— There is a general net production of collagen for about 21 days, after which there is a net loss and a changing proportion of type III {Immature} to type I {Mature} collagen. The collagen helices also undergo cross linking to increase the strength. The overall strength of this new collagen gradually increases for about 6 months, resulting in a relatively less elastic tissue that has only 70% to 80% of the strength of the native connective tissue. It is for this reason that the permanent strength of a prosthetic is important for the best long-term success of hernia repair.

— To understand what sort of properties a mesh should have , it is important to look at the tissues it is replacing and/or reinforcing. Klinge and collegues described a mathematical model that calculated the force of the abdominal wall to be 16N/cm. The same group also examined the elasticity of the abdominal wall in human cadavers. They described the average male abdominal wall elasticity at 16N to be 23 {±7%} and 15{±5%} in the vertical direction and 15{±5%} in the horizontal direction, while the average female abdominal wall elasticity at 16N was 32 {±7%} in the vertical direction and 17 {±5%} in the horizontal direction.

Properties Of Polypropylene Mesh [64]:

— Polypropylene (–CH2 – CH (CH3) – is a thermoplast based propane with molecular weight of 100,000. It is readily available, strong and non absorbable.

— It is a monofilament that is inert, porous, thin and firm, but pliable.

— Polypropylene mesh is not rejected by the body and is able to withstand

infection. A disadvantage is the high bending stiffness of the monofilaments. Nevertheless, most of the current meshes are built of monofilaments.

— Density of standard polypropylene mesh {Heavyweight mesh} is 80-85g/m^2 with pore size of100-600µm.

— Tensile strength is 89N/cm.

— Elasticity as given by percentage stretch at 16N/cm tension is 6%.

— Microscopically, it initiates an intense foreign body inflammatory reaction, its interstices are infiltrated completely by fibroblasts, with subsequent dense fibrous scar formation. Direct contact with the intestine has to be prevented very carefully because polypropylene meshes tend to form intense adhesions and later fistulas.

— As a consequence of physiologic wound contraction, depending largely on the extent of inflammation, the polypropylene meshes show considerable shrinkage of about 20% in length, and 40% of the original area, sometime folding and forming shaggy edges.

— The induction of an intense fibrosis entirely embedding the mesh into a scar plate is frequently followed by a restriction of the abdominal wall mobility as complained by the patient. This problem is being tackled by the introduction of new light weight polypropylene meshes.

Fig no.33 Hernia Kit

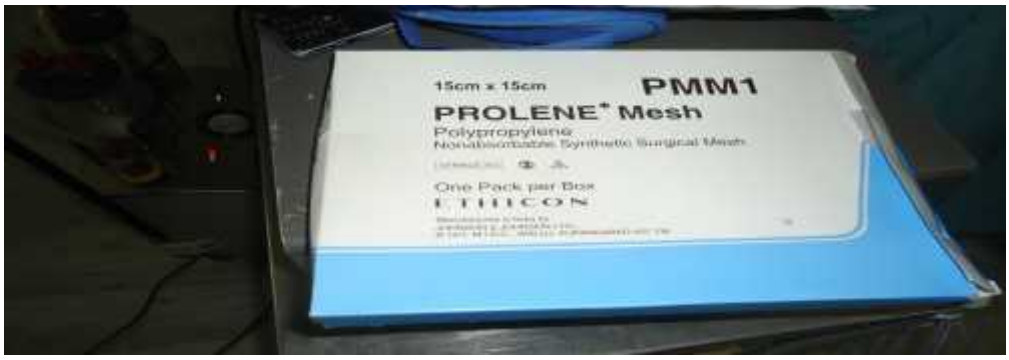


Fig no..34 Prolene Mesh 15cms*15cms

Fig No 35 Ultrapro Mesh

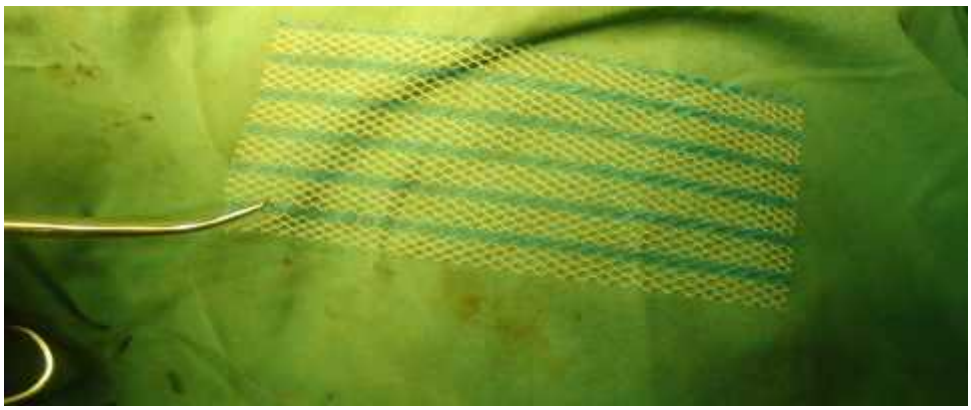


Fig No.35 a.Ultrapro mesh 6cm*11cm

Fig no.36.Standard Prolene Mesh{blue} & Lightweight mesh {green} 7.6cm*15CM

Fig No.37 Lightweight mesh 6cm*11cm {green}

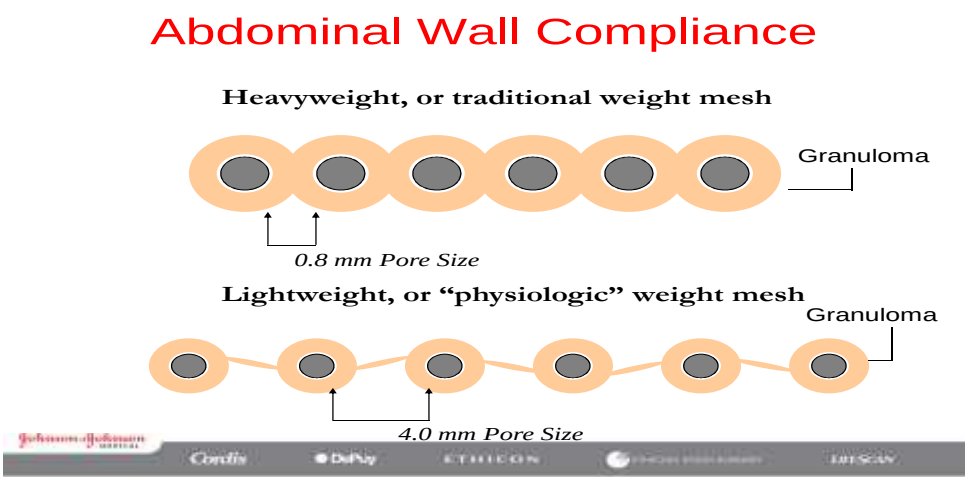


Fig No.38 Abdominal wall compliance after mesh placement

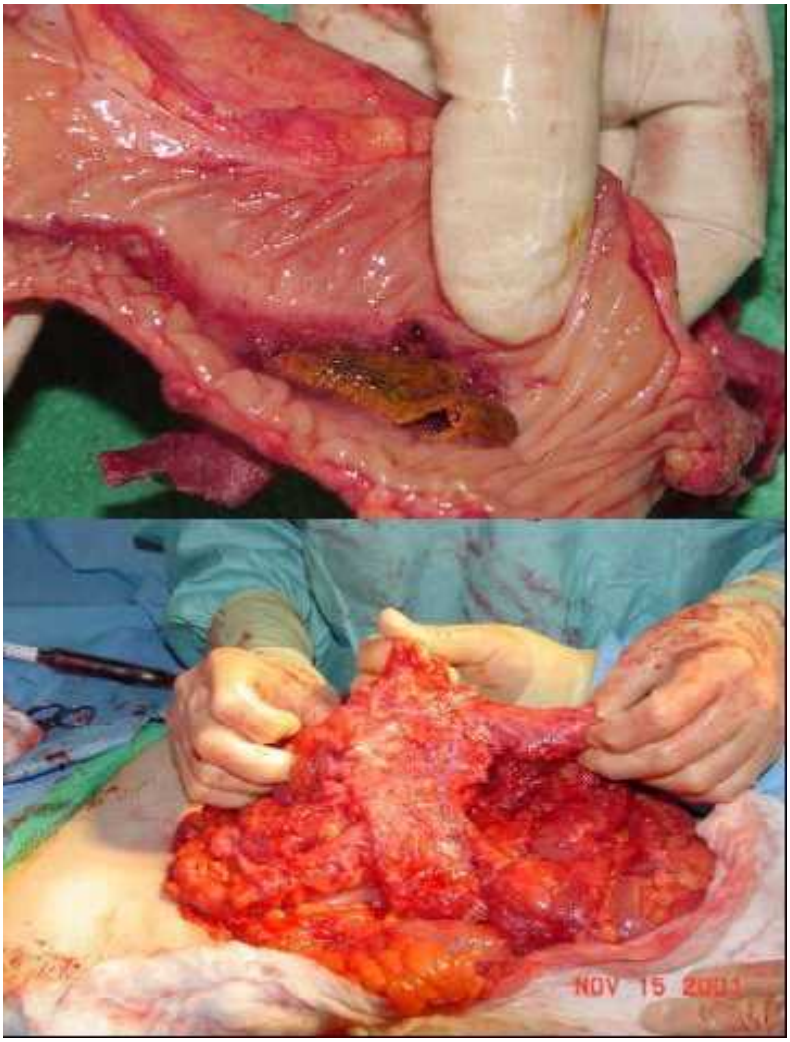
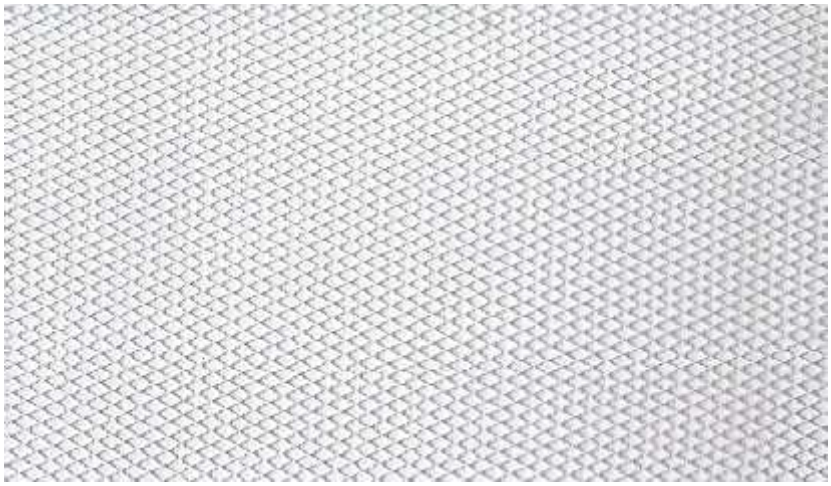


Fig no.39 Polypropylene Mesh Disadvantages

VYPRO* Composite Mesh



Elasticity

The Ability to be Stretched in all Directions (also diagonal)

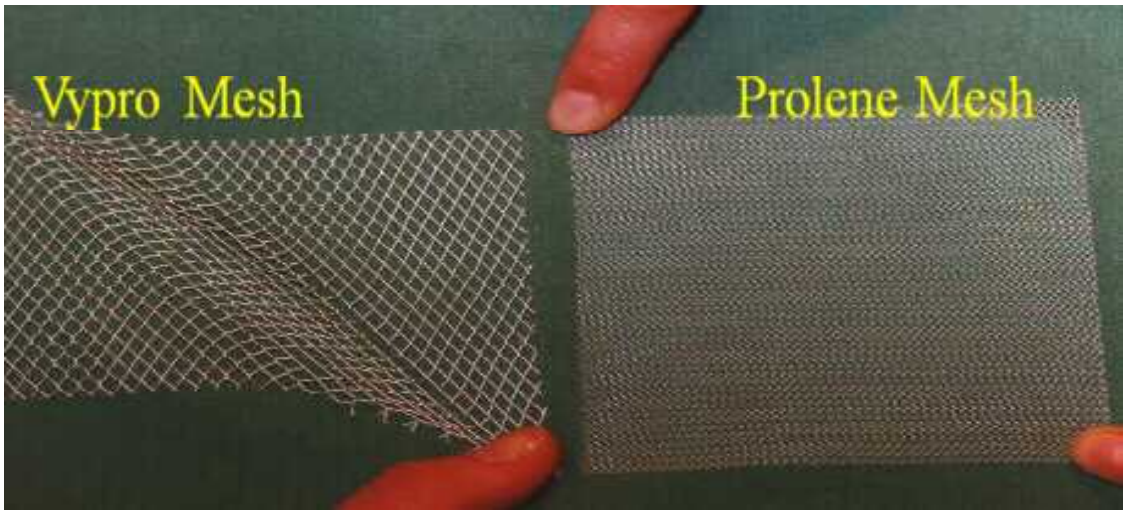
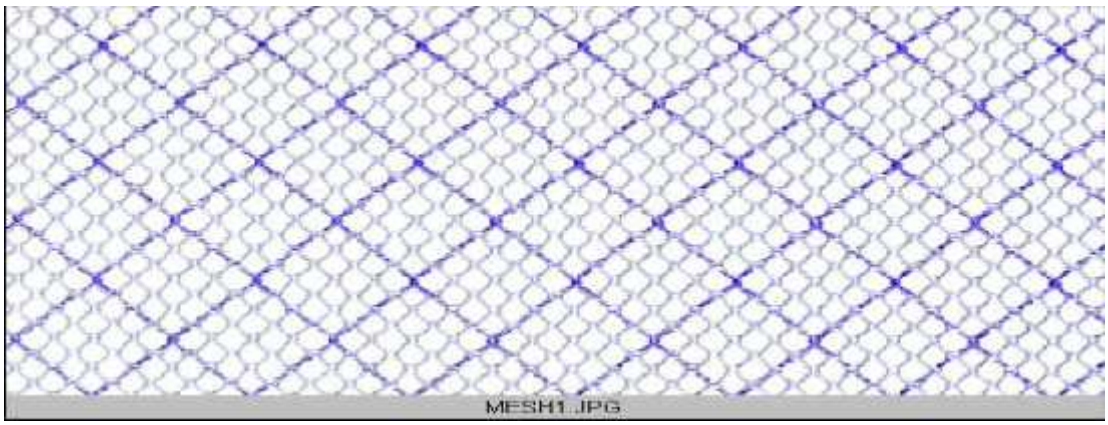


Fig no.40 Differnet Lightweight Mesh with their Elasticity Comparison

VYPRO II out of the package



VYPRO II after absorption of VICRYL component

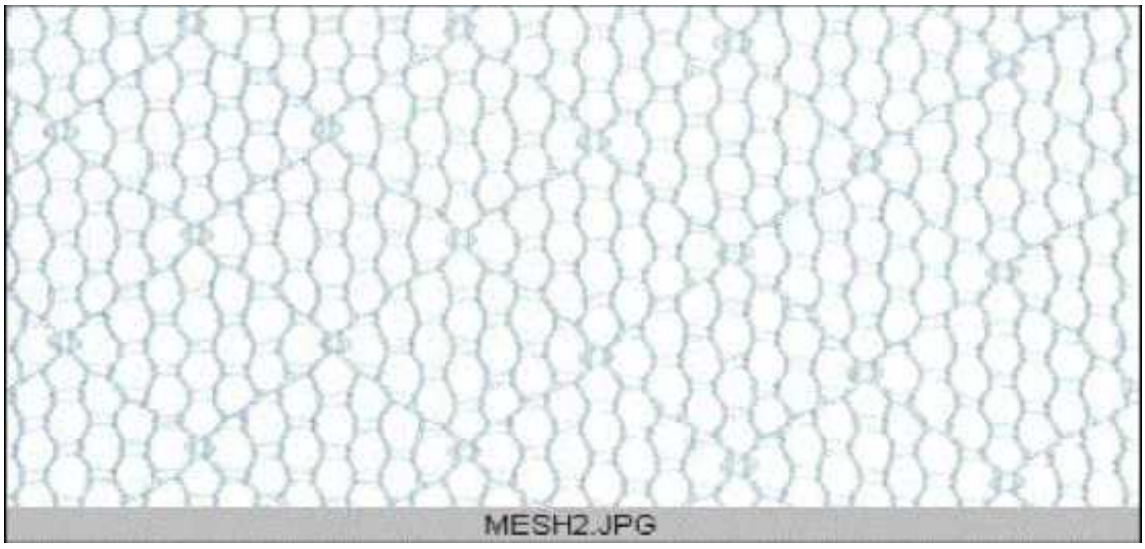


Fig no.41 Vypro II Mesh before & after Absorption

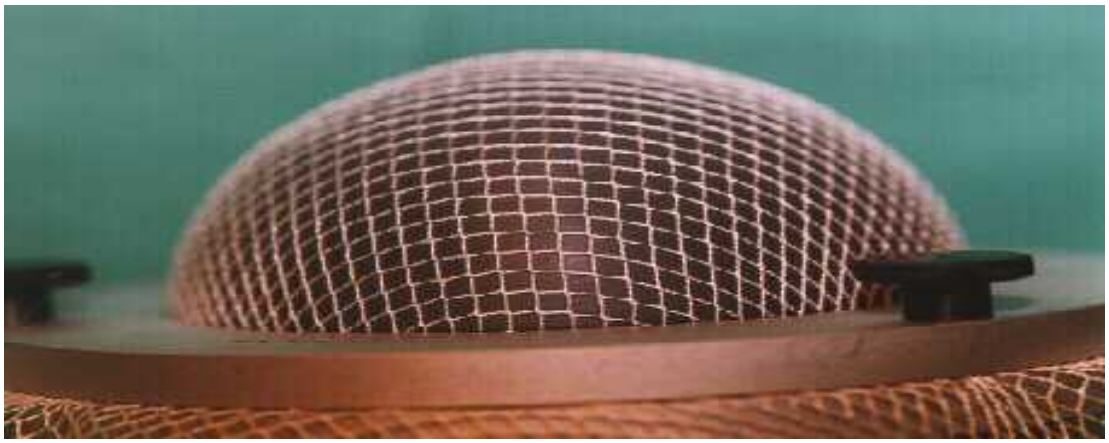


Fig no.42 Flexible Stretching Resistance Conforming to Anatomical Strains of Abdominal Wall

Fig n.43 Big Pore Size

MESH RELATED COMPLICATIONS [52]

- **Infection**: Caused by infiltration and proliferation of bacteria into and within the pores and interstices of these synthetic materials.
- **Seroma formation**: Caused by host inflammatory reaction to the prosthesis, and by the dead space created between the prosthesis and host tissue.
- **Intestinal adhesion and bowel obstruction**: Adherence of meshes to the bowel when they come in direct contact with the intestinal tract.
- **Enterocutaneous fistula:** Erosion of the prostheses into the adjacent hollow viscous,
- **Shrinkage:** Due to contraction of the prostheses leading to failure of the repair.

PATHOPHYSIOLOGY OF PROSTHETIC INFECTIONS IN HERNIOPLASTY [53]

Current rate of infection for hernioplasty is at around 1-2%. In addition, infection is associated with a high recurrence rate. Hence, thorough knowledge of the pathogenesis of mesh infection is essential to reduce infection rates and its proper management.

BACTERIAL ENTRY: Bacteria enter wounds from the air in operating room, bodies of the operating team, from errors in draping, and from perforated gloves.

BACTERIAL BINDING: After entry bacteria produce an adhesive substance (adhesion) designated as microbial surface components recognizing adhesive matrix molecules (MSCRAMMs), which plays an important role in bacterial binding to ECF, cells and prosthesis.

Prosthetic surfaces possess binding sites that, when interacting with live tissue, acquire a film of glycoproteinaceous layer, if bound, bacteria exposed to this layer for sufficient time, start developing molecular cross links with the layer, producing an almost irreversible attachment to the layer. Under these circumstances bacteria commence nourishing from the surrounding body fluids and form an extracapsular "polysaccharide film", which in association with tissue debris allows it to remain in permanent contact with the prosthesis, a layer in which bacteria can thrive and to which antibiotics may not reach.

BACTERIAL SURVIVAL: Once in the wound bacterial survival depends on their idiosyncratic characteristics for eg. Staphylococcus epidermidis, an otherwise saphrophytic bacterium colonizing the skin, may turn biologically aggressive when incorporated on prosthetic surfaces.

DIMINISHING BACTERIAL ENTRANCE:

Short pre-operative hospitalization

Preoperative showering: Advise patients to shower or have a bath (or help patients to shower, bath or bed bath) using soap, either the day before, or on the day of, surgery[54].

Hair removal: Use electric clippers with a single-use head on the day of surgery[35].

CONCEPT OF LIGHTWEIGHT MESH[68,70,71]

Methods to decrease the density of the prosthetic include reduction in fiber diameter{ ie.strength } and number of fibers{ ie.increase in pore size }. Laboratory studies suggest that the prosthetic should have at least 16N/cm strength to avoid disruption and maintain proper fixation to the tissues.

- The tensile strength of surgical meshes for abdominal wall replacement in large hernia where mesh has to replace all structures of abdominal wall without fascia closure is 32N/cm at maximum.
- In small hernias where fascia can be closed tensile strength of mesh required is 16N/cm, therefore prolene is over engineered for their work. This excess prosthetic can lead to more complications, including decreased mesh flexibility, loss of abdominal wall compliance, inflammation, and scarring of surrounding tissues, potentially leading to pain, a sensation of feeling the mesh in the abdominal wall, and mesh contraction and wadding, which in turn may result in a recurrent hernia.
- Lightweight meshes are designed to mimic the physiology of the abdominal wall and the inguinal region. Meshes in this group are produced with small polymer fibres, large pores{ >1mm } and a high flexibility. Surface area in contact with the host tissue is low[5].
- Abdominal wall mean distension (elasticity) at a physiological strain of 16N ranges between 11 and 32%. Textile analysis of heavyweight meshes revealed an elasticity of only 4-16% at 16N whereas that of Ultrapro is 25% at 16N therefore restricting abdominal wall and causing stiffness whereas lightweight

mesh with similar elasticity to the abdominal wall demonstrates superiority with respect to a physiologic abdominal wall repair.

- In abdominal wall augmentation in small hernias {where the fascia can be closed },the tensile strength of the mesh can be reduced to 16N/cm. Tensile strengths of more than 100N/cm of conventional heavyweight meshes are therefore disproportional and not required for an effective fascia closure or augmentation and lead to low flexibility with a subsequent restriction of the abdominal wall discomfort of the patient. However the Foreign body reaction depends not only on polymer but also the surface area in contact with the host tissues. The surface area again strongly depends on textile properties such as pore size or the diameter and number of fibers used. The lightweight and large pore size meshes have less surface area than the heavyweight mesh group consequently, the FBR in the lightweight mesh group is significantly reduced. In addition to this significantly decreased typical chronic inflammatory reaction, the fibrotic reaction around the mesh in total as well as around each single mesh fibre is greatly reduced. The fibrotic reaction as a result of the inflammatory response, however, considerably influences long term quality of the hernia repair. Today the tissue response to the mesh is understood as a chronic wound persisting over many years at the interface of the mesh and recipient tissues.

LIGHTWEIGHT MESH COMMONLY BEING USED ARE

ULTRAPRO: Represents the newest member in the lightweight large porous mesh group. The mesh is constructed of a mono filament lightweight large porous PP mesh with pores of more than 3mm. Its density is 28g/m^2 . Thickness is 0.5mm. An absorbable Monocryl (polyglecaprone 25) component is added to improve handling

characteristics and to optimize implantation and increased tensile strength in the first week of the repair.

Monocryl (polyglecaprone 25) is a monofilament derived from a segmented copolymer of e-caprolactone and glycolide. This complex polymeric system contains soft segments of a random copolymer of e-caprolactone and glycolide, which provide good handling characteristics and hard segments of polyglycolide that provide high strength. Both soft and hard segments are combined in the same polymeric chain. Evaluating the toxicity potential of monocryl sutures, no genotoxic, cytotoxic, teratogenic, irritating or allergic effects were found. Monocryl is essentially absorbed without increased cellularity, inflammatory and fibrotic reaction within 84-140 days. Interestingly the supplement of PP with monocryl leads to significantly decreased FBR compared with simple lightweight large porous meshes with identical textile structure; an effect still under investigation. Overall, the Monocryl-PP-composite Ultrapro is currently the member of the lightweight large porous mesh family with the lowest FBR and optimized handling. The first clinical studies produced encouraging results to move forward with the mesh concept.

VYPRO: The concept of lightweight large porous mesh for hernia repair was first realized in 1998 with the introduction of Vypro by Ethicon, Germany. The amount of remaining material was reduced to approximately 30% of common heavyweight meshes { Vypro 24g/m^2 vs Prolene 80-85g/m^2 } and the pore size was increased by up to 500-600% { Vypro 3-5mm vs Prolene <1mm }. The non absorbable part is composed of multifilament PP combined with an absorbable part made of Vicryl (PG910). Polypropylene part is 27g/m^2 and Polyglactin 910 part is 27g/m^2. Vicryl part is absorbed in first 6 weeks after implantation. Tensile strength is 16N/cm. Elasticity

is 31% when tension of 16N/cm is applied. Can be used for inguinal hernia repair where fascia can be closed.

VYPRO II: In this composite mesh polypropylene part is 35g/m^2 and polyglactin part is 45g/m^2 , density is 30g/m^2 . Tensile strength is 32N/cm. It can be used in larger hernias where fascia closure is not possible.

MESH SHRINKAGE:

It is not the mesh that shrinks, but the surface reduction is due to a simple retraction of the fibrotic scar tissues around the mesh. Retraction of the scar is a physiologic reaction of maturing scar started by a constant water loss and a subsequent surface area decrease to an average of 60% of the former wound region. It has been assumed lightweight meshes with a notably decreased fibrotic tissue reaction demonstrate a lesser degree of shrinkage, a hypothesis that still has to be confirmed. Nevertheless, shrinkage is highly important for the repair technique. Sufficient long term hernia repairs can only be performed with large meshes overlapping the hernia gap by a minimum of 5 cm each side.

Silvestre AC et al in their study of shrinkage evaluation of heavyweight and lightweight polypropylene meshes in inguinal hernia repair concluded that there is significant differences between the two meshes comparing the total area initially and on postoperative day 90 {P=0.001}. The HWM had significantly less area initial area, as compared with 90 days postoperatively { P=0.04}[72]

FIBROTIC BRIDGING: SCAR PLATE AND SCAR MESH

Fibrotic bridging is a phenomenon closely associated with the occurrence of shrinkage. Bridging occurs in all mesh modifications with a granuloma size around

each mesh fibre exceeding more than half of the pore size of the mesh. Usually, the phenomenon of bridging is observed in all mesh modifications with pore sizes of less than 1 mm. In all of these cases a granuloma of one fibre starts to become confluent with granuloma formations of the adjacent fibres and thus eventually the whole mesh is incorporated into a larger area of granuloma side by side. However, elicit a common outer fibrotic capsule joining each mesh fibre and forming a scar plate covering the whole mesh. The scar plate again results in the mesh becoming stiff and nonflexible. Conversely, stiff and non flexible mesh repairs appreciably manipulate the abdominal wall function and quality of life. In contrast, lightweight meshes with large pores are constructed in such a way that the granuloma is always notably smaller than half of the pore size. In some of these meshes, the pore size was increased more than six times compared with the conventional heavyweight meshes, such that bridging is not possible. Light weight large pore size mesh modifications are characterized by a localized fibrotic reaction around the mesh fibres, with small granulomas allowing the mesh to stay flexible and smooth after implantation.

RECURRENCE:

In a meta-analysis of 6 randomized controlled trials that included 1936 hernia patients, comparing lightweight and heavyweight mesh for Lichtenstein inguinal hernia repair it was found that there was no difference in recurrence rate between lightweight mesh and heavyweight mesh patients.[73]

CHRONIC PAIN

One of the most common sources of postoperative morbidity in surgical patients is the occurrence of post herniorrhaphy chronic groin pain, defined as pain that persists after

the normal healing process has occurred typically 3 months after surgery. Chronic groin pain is most often a result of nerve injury sustained during improper dissection.

When the groin is explored via the anterior approach, one may encounter the ilioinguinal nerve, the genital branch of the genitofemoral nerve, and the ilohypogastric nerve. The ilioinguinal nerve can usually be identified lateral to the internal ring.The genital branch of the genitofemoral nerve can be identified in the lateral crus of the internal ring. Another possible anatomic location of this nerve is between the spermatic cord and inguinal ligament. The iliohypogastric nerve can be identified by separating the aponeurosis of the external oblique from the internal oblique muscle. The iliohypogastric nerve is the regional nerve that is at the highest risk during tension-free repair because it can be trapped by the overlapping mesh in the scar tissue that forms between the mesh and the muscle plane along which the nerve runs.

The ilioinguinal nerve is at the most risk for entrapment because it lies immediately beneath the divided external oblique fascia and can be included in sutures used for the hernia repair or to re approximate the external oblique fascia. Mesh placed atop the internal oblique fascia/ muscle can adhere to the ilioinguinal and /or iliohypogastric nerves during healing. Several authors detail methods for prevention of nerve injury and stress the need for understanding inguinal anatomy and preservation of the nerves during hernia repair and inguinal incision closure.

The most crucial preventative step to reduce the incidence of postoperative groin pain is careful dissection and preservation of the ilioinguinal, iliohypogastric, and genitofemoral nerves. It has been demonstrated that when all three nerves are

identified and preserved, no cases of chronic pain were identified at 6-month follow-up.

In the Post retrieval study, most explants from all the patients with chronic pain in their medical study indicate nerve fibers and fascicles in the interface of the mesh. Immunohistochemical stains allow the detection of even the smallest nerve structures that are mainly found in or around the foreign body granuloma. Due to the nature of the granuloma as a chronic inflammation, it may be speculated that these nerve structures are irritated by the inflammation and cause the sensation of pain. In some cases real traumatic neuroma can be found at the interface of the mesh-recipient tissues, an indicator of the mechanical destruction of the nerve by the mesh. In total, all mesh modifications with small pores reveal unacceptably high rates of chronic pain in the retrieval body, in particular, all heavy weight PP meshes. Vypro, a light-weight large pore- constructed mesh, demonstrates a dramatically reduced surface area compared with heavyweight mesh. In combination with a favourable foreign body reaction, the small surface area leads to a minimal nerve irritation and destruction.

Post.S, et al , in their randomized clinical trial of light weight composite mesh for Lichtenstein inguinal hernia repair on 122 hernia patients concluded that light weight mesh was associated with less pain on exercise after 6 months($P=0.042$)[74]

Bringman .S,et al, in their 3 year results of randomized controlled trial of lightweight or standard prolene mesh in Lichtenstein repair of hernia of 590 patients concluded that patients who had light weight mesh had less pain on examination, less pain on rising from lying to sitting position[75].

In a meta-analysis of 6 randomized controlled trials that included 1936 hernia patients, comparing lightweight and heavyweight mesh for Lichtenstein mesh was associated with reduced chronic pain { $P<0.01$ }[73]

FOREIGN BODY SENSATION

Heavyweight meshes form scar plate due to foreign body reaction and are less flexible and thus its presence can be felt on bending down. On the contrary lightweight mesh form scar mesh due to foreign body reaction and are flexible and thus felt less often.

Post.S,et al , in their randomized clinical trial of lightweight composite mesh for Lichtenstein inguinal hernia repair on 122 hernia patients concluded that use of lightweight mesh reduced foreign body sensation after 6 months to less than half of incidence reported with use of conventional densely woven polypropylene mesh[74].

TIME TO RETURN TO NORMAL ACTIVITY

Convalescence and return to normal activities and work is very subjective at times and depends upon the nutritional state of the patient, age of the patient and type of work he does. Elderly patients and those who are undernourished are likely to have longer periods of convalescence. Some authors believe patients should be able to return to normal as soon as resolving pain permits. The major factors affecting return to activity are motivation and financial activities.

O'Dwyer PJ et al in their randomized controlled trial experienced that mean time taken to return to normal activities with lightweight mesh is 21 days and standard prolene mesh is 26 days[76].

M.Smietanski et al in their randomised controlled trial comparing a polypropylene mesh with a polyglecaprone and polypropylene composite mesh for inguinal

hernioplasty concluded that use of partially absorbable mesh reduced postoperative pain at day 7 compared to heavy weight mesh and thus early return to normal activity[77].

IMMEDIATE POST OPERATIVE COMPLICATIONS. SEROMA

S.Post et al, in their randomized controlled trial experienced seroma collection in 21 patients in lightweight mesh group compared to 20 patients in heavyweight mesh group (P-0.579) . Thus concluded there is no statistical difference between two mesh groups in terms of seroma formation.

WOUND INFECTION

Due to the results of the retrieval study, all mesh modifications seem to have similar infection rates. Multifilament mesh constructions reveal no higher rates of infection as the reason for explanation. Further-more, scanning electron microscopy studies indicate that colonies of bacteria including biofilm-forming colonies of staphylococcal epidermidis from skin , persisting at the surface of the polymer fibers may be responsible for late infection months or, in rare instances, years after the initial operation.

M.Smietanski et al in their randomized controlled trial experienced no wound infection in both mesh groups .

HAEMATOMA:

S.Post et al and M.Smietanski et al in their randomized controlled trials did not find statistically significant difference in haematoma formation between two mesh groups with P-0.673 and P-0.279 respectively.

IMMEDIATE PAIN

M.Smietanski et al in their randomized controlled trial experienced that The lightweight group reported less pain on day 7 { 55.2 versus 36.2 per cent; P <0.001 } compared with heavyweight mesh group.

METHODOLOGY

SOURCE OF DATA:

All patients presenting to B.L.D.E.U's Shri B.M.Patil Medical College Hospital and Research Centre Bijapur and admitted patients in whom the diagnosis of inguinal hernia is considered from October 2012 to April 2014.

Method of collection of data:

- This is a randomised controlled trial study in which patients presenting with unilateral primary uncomplicated indirect and direct inguinal hernias in B.L.D.E.U's Shri B.M.Patil Medical College Hospital will be taken up into study.
- Two groups are made, Ultrapro lightweight mesh for one group and standard prolene mesh to another group.
- Minimum of 50 cases with permissible error in each group will be taken up for the study.
- The period of study is from October 2012 to April 2014.
- Diagnosis of unilateral primary uncomplicated indirect and direct inguinal hernia was made on the basis of thorough clinical examination, appropriate laboratory and radiological investigations.
- A pretested structural proforma will be used to collect relevant information for each individual patient selected.
- Data will be entered on master chart for analysis.
- The data will be analysed by using student t- test, Chi square test, Mann Whitmy test, & Fischer exact tests wherever needed respectively.
- Cases will be selected consequently with following inclusion and exclusion criteria.

Inclusion criteria:

- Men 20 years of age or older with unilateral/bilateral primary inguinal hernia.

Exclusion criteria:

- Any recurrent hernias.
- Presence of bowel obstruction, strangulation, peritonitis or perforation.
- Associated femoral hernia.
- Patients undergoing orchidectomy in the same procedure.

Follow up:

- Early complications (within 1 month): Pain, seroma formation, hematoma, wound infection rate.
- Late complications: Chronic pain using visual analogue scale {3 to 6mths}, foreign body sensation, and time taken to return back to normal work { A. light physical work repeating daily lifting of <10kg } after 3 and 6 months.

Research hypothesis:

Lightweight mesh was having better outcomes when compared with standard prolene mesh in terms of complications like pain, seroma, hematoma and infection within 1 month of follow-up and chronic pain {3 to 6 months}, foreign body sensation and time taken to return back to normal work {A.light physical work repeating daily lifting of <10kg} after 3 and 6 months.

Sampling:

Study period from: October 2012 to April 2014.

All the patients admitted during this period, who fulfil the inclusion criteria, will be included in this study.

1. Estimation of sample size.

The sample size for estimating the proportion of standard prolene mesh incidence at the permissible error e = 0.1048447 with 5% level of significance (with the reference of standard prolene mesh incidence p = 0.827 i.e. 82.7%) is given by

$$n = \frac{Z\alpha^2 pq}{e^2}$$

$$n = \frac{1.96^2 * 0.827 * 0.173}{0.1048447^2} = 50$$

- $\underline{Z\alpha^2}$ – critical value of standard normal variate at 5% level of significance
- Permissible error - difference between estimator and true value of parameter.
- q = 1-p
- The reference of standard prolene mesh incidence p = 0.827 i.e. 82.7% and light weight mesh is given by p = 0.848 i.e. 84.8% taken by the article three – year results of a randomized clinical trial of lightweight or standard polypropylene mesh in Lichtenstein repair of primary inguinal hernia Br J Surj 2006 Sep 93(9) 1056 – 9.
- The sample size for estimating the proportion of light weight mesh incidence at the permissible error e = 0.0997834 with 5% level of significance (with the reference of light weight mesh incidence p = 0.847 i.e. 84.7%)

$$n = \frac{Z\alpha^2 pq}{e^2}$$

$$n = \frac{1.96^2 * 0.847 * 0.153}{0.0997834^2} = 50$$

- $\underline{Z\alpha^2}$ – critical value of standard normal variate at 5% level of significance

- Permissible error - difference between estimator and true value of parameter.
- q = 1-p
- The reference of standard prolene mesh incidence p = 0.827 i.e. 82.7% and light weight mesh is given by p = 0.848 i.e. 84.8% taken by the article three – year results of a randomized clinical trial of lightweight or standard polypropylene mesh in Lichtenstein repair of primary inguinal hernia Br J Surj 2006 Sep 93(9) 1056 – 9.

2. Student's t – test, Chi square test, Mann Whitmy test, & Fischer exact tests were used to compare the effect of standard prolene mesh and lightweight mesh based on the complications under study.

For lightweight mesh a 2.4"x4.3" { 6cm x 11cm} and 7.6cmx15cm {3inches x 6 inches} and 15cms* 15cms polypropylene meshes made by Ethicon company and Ultralite made by Lotus company were used. The mesh has pore size of more than 3mm and has a density of 28g/m^2. It is sterilized by ethylene oxide gas by the manufacturer. Polypropylene 2-0 was used to suture the mesh in place.

Similarly for standard prolene mesh hernia repair, prolene mesh of 2.4"x 4.3" and 3inches X 6 inches made by Ethicon company, Lotus company and henia kits made by Sutures India company were used. The mesh has pore size of less than 1mm and has a density of 80-85g/m. It is sterilized by ethylene oxide gas by the manufacturer. Polypropylene 2-0 was used to suture the mesh in place. A single dose of Inj.Ceftrioxone + Sulbactam 1.5 gm was given intravenously immediately before the surgery.

The note was taken of the contents of the sac, and any technical difficulty encounterd during the surgery.

Postoperatively patient was put on Inj.Ceftrioxone + Sulbactam 1.5 gm BD intravenously for two days and injection Dynapar aq iv BD for 2 days . The patients were followed up for postoperative pain which was evaluated using visual analogue scale, wound hematoma, wound seroma, wound infection.

Sutures were removed on the 7^{th} postoperative day and the patients discharged if there was no wound infection, were ambulatory, were taking orally and felt comfortable. Patients were called to the outpatient department and follow up was done at 1,3 and 6 months for complications like chronic groin pain (inguinodynia), foreign body sensation . Patients were assessed for postoperative pain using visual analogue scale after 1 ,3 & 6 months after surgery. Visual analogue scale consists of a 10 cm line anchored at one end by a label as no pain and at the other end by a label such a severest pain patient experienced in his life time. We translated this for documentation as a 1-3 mild pain, 3-7 moderate pain, 7-10 severe pain.

Time taken to return to normal activity was enquired during their follow up visit after 3 & 6 months.

TIME TO RETURN TO NORMAL ACTIVITY:

All patients were encouraged to return to work as soon as possible. Patient in both the groups were followed and the post operative time period that elapsed between day of surgery and the day of joining of duty at their work place was recorded and compared.

Technique for Lichtenstein's Hernioplasty:

After thoroughly painting with betadine 10%v/v, drapes were put. A 5cm incision was made starting from the pubic tubercle medially to the position of the internal ring laterally{2.5cm above & parallel to medial 3/5^{ths} of the inguinal ligament}. The skin incision was deepened. The external oblique aponeurosis was opened and its lower leaf freed from the spermatic cord. The upper left of the external oblique was freed from the underlying internal oblique muscle and aponeuroses. The spermatic cord was mobilised by hooking an index finger around it near pubic tubercle. A thorough search was made for any direct sac. If present the direct sac was inverted and imbricated using a nonabsorbale suture { Prolene2-0 } to flatten the posterior wall. The cremasteric sheath was incised longitudinally and the cord structures separated out and a search for any indirect sac was made.

The indirect sac, if found, was freed from the cord to a point beyond the neck of the sac. The sac was opened. Any contents of peritoneal cavity present were removed by twisting the sac. The sac was then transligated and excised. To minimize the risk of postoperative ischemic orchitis, complete nonsliding scrotal hernia sacs were transacted at the midpoint of the canal, leaving the distal section in place.

A sheet of 2.4"x 4.3"polypropylene { Prolene } or lightweight { Ultrapro} onlay mesh was sutured with polypropylene 2-0 continuous sutures into place. The medial end of the mesh was cut out to the shape of the medial corner of the inguinal canal. The inferomedial border of the mesh was sutured to the soft tissues overlying pubic tubercle after obtaining 2-3 cms of overlap here. The periosteum of the bone was avoided.

The inferior border of the mesh was attached to the inguinal ligament with a loose continous polypropylene suture. A slit was made at the lateral end of the mesh, creating two tails a wider above and a narrower below. A 3mm circular place of mesh was removed at the medial end of the slit for positioning the cord. The wider upper tail was passed around the cord, and sutured along with the narrower tail to the inguinal ligament with loose continous suture. Similarly the upper end of mesh was sutured to conjoint tendon.

During the procedure every care was taken to prevent entrapment of ilioinguinal as well as iliohypogastric nerves in the sutures.

The external oblique aponeuroses was closed using prolene 2-0 and skin closed by interrupted sutures with ethylon 2-0.

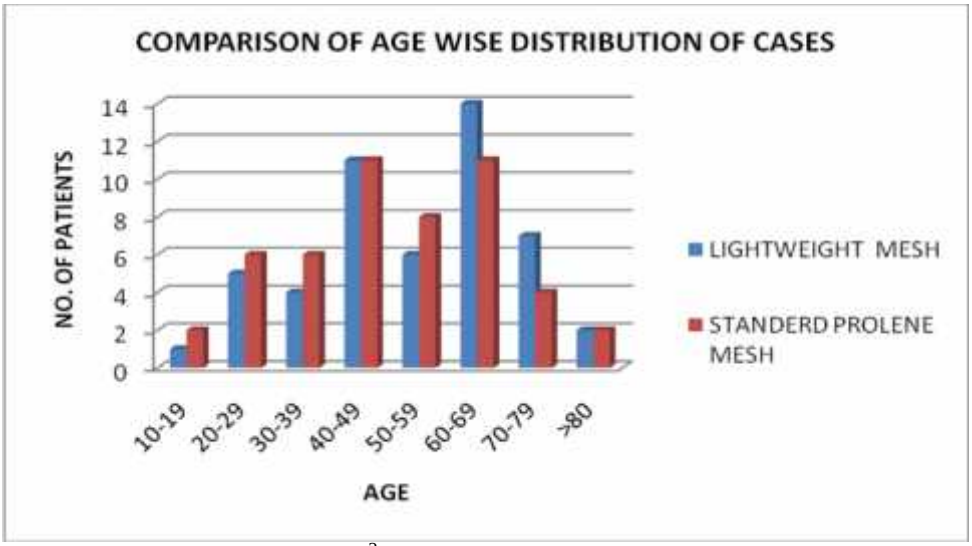
All inguinal hernias share the common feature of emerging through the Myopectinaeal Orifice of Fruchaud, the opening in the lower abdominal wall bounded above by the myoaponeurotic arch of the lower edges of the internal oblique and the transverse abdominis muscle. And below by the pectineal line of the superior pubic ramus.

RESULTS

TABLE NO: 4 AGE DISTRIBUTION

AGE IN YEARS	LIGHTWEIGHT MESH n(%)	STANDARD PROLENE MESH n(%)
10-19	1{2}	2{4}
20-29	5{10}	6{12}
30-39	4{8}	6{12}
40-49	11{22}	11{22}
50-59	6{12}	8{16}
60-69	14{28}	11{22}
70-79	7{14}	4{8}
>80	2{4}	2{4}
TOTAL	50{100}	50{100}

GRAPH NO 1



X^2-2.288 P-0.9422 NS

In the present study age of the patient varied from 10 to < 80 years with the highest prevalence noted in the age group of 61-70 years.

	MEAN+ STANDARD DEVIATION
LIGHTWEIGHT MESH n(%)	52.74±16.53
STANDARD PROLENE MESH n(%)	49.08±17.04

TABLE NO 5: SEX DISTRIBUTION

SEX	LIGHTWEIGHT MESH n(%)	STANDARD PROLENE MESH n(%)
MALE	50{100}	50{100}
FEMALE	0	0
TOTAL	50	50

Present study shows 100% are male with 0% of female presenting with inguinal hernia.100% Difference noted as there were no female patients underwent standard Lichtenstein tension free hernia repair in both the groups.

GRAPH NO 2

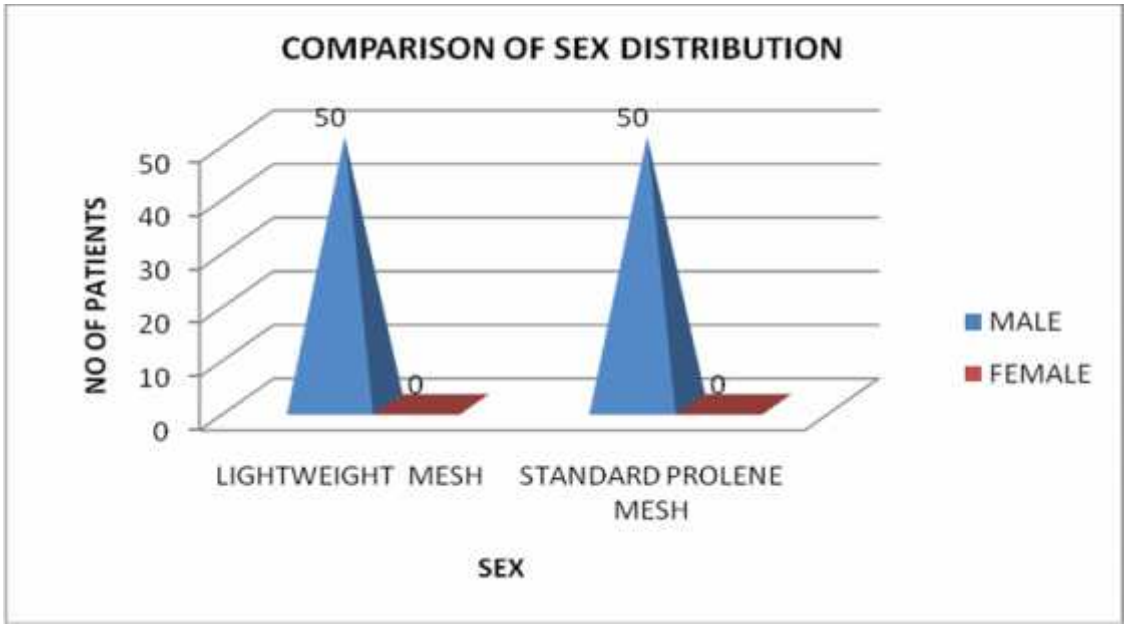


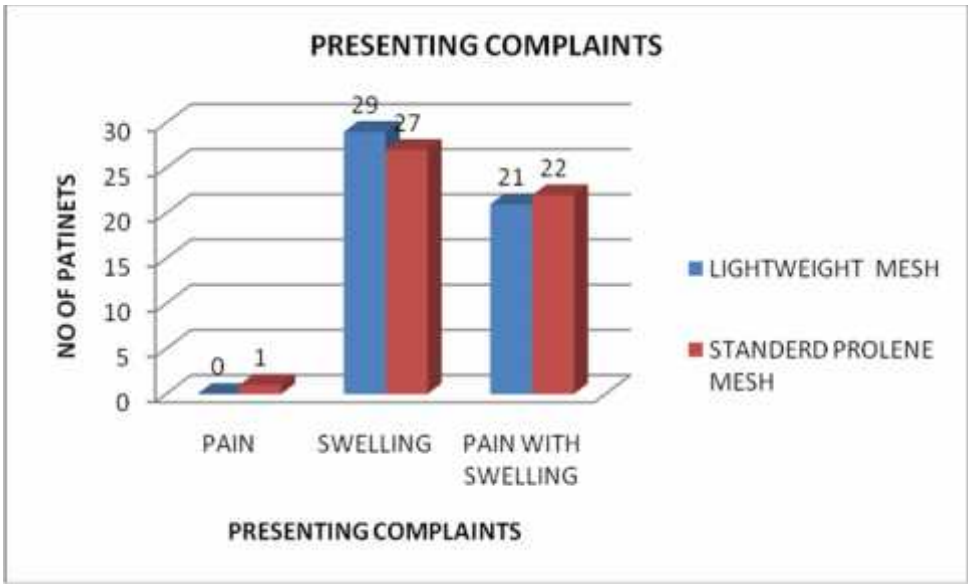
TABLE NO 6: PRESENTING COMPLAINTS

COMPLAINTS	**LIGHTWEIGHT MESH n(%)**	**STANDARD PROLENE MESH n(%)**	**TOTAL**
PAIN	0	1{2}	**1**
SWELLING	29{58}	27{54}	**56**
SWELLING WITH PAIN	21{42}	22{44}	**43**
TOTAL	**50{100}**	**50{100}**	**100**

Number in parenthesis indicates percentages.

X^2-1.095 P-0.5785 NS

GRAPH NO 3



Only one patient presented with complaint of only pain without swelling.

TABLE NO 7: DURATION OF SYMPTOMS { Swelling }

SWELLING	LIGHTWEIGHT MESH n(%)	STANDARD PROLENE MESH n(%)
<6 MONTHS	24{48}	19{38}
6 MONTHS-1 YEAR	12{24}	16{32}
1-3 YEARS	7{14}	11{22}
3-5 YEARS	4{3}	2{4}
>5 YEARS	3{6}	2{4}
TOTAL	50{100}	50{100}

X^2-2.908 P-0.5733 NS

Majority of patients had complaint of swelling in <6 months group.

GRAPH NO 4

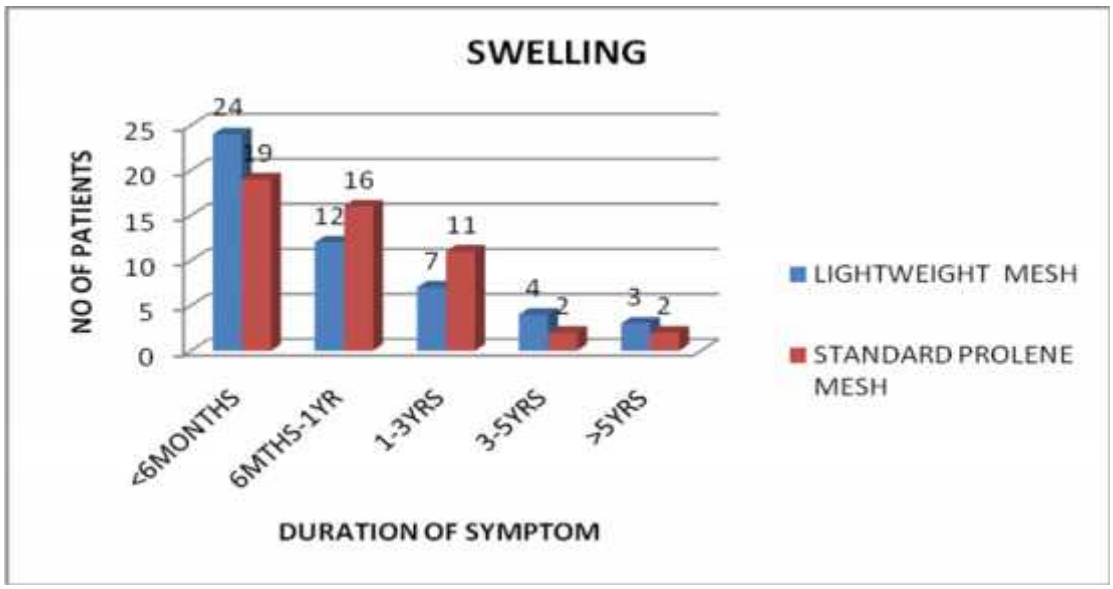


TABLE NO 7a: DURATION OF SYMPTOMS { Pain }

PAIN	**LIGHTWEIGHT MESH n(%)**	**STANDARD PROLENE MESH n(%)**
<6 MONTHS	**19[38]**	**21[42]**
6 MONTHS-1 YEAR	**4[8]**	**1[2]**
1-3 YEARS	**1[2]**	**1[2]**
NO PAIN	**26[52]**	**27[54][**
TOTAL	**50[100]**	**50[100]**

Number in parenthesis indicates percentages.

Here also majority of patient presented to surgical opd with complaint of pain with < 6months duration in both the groups.

GRAPH NO 4a

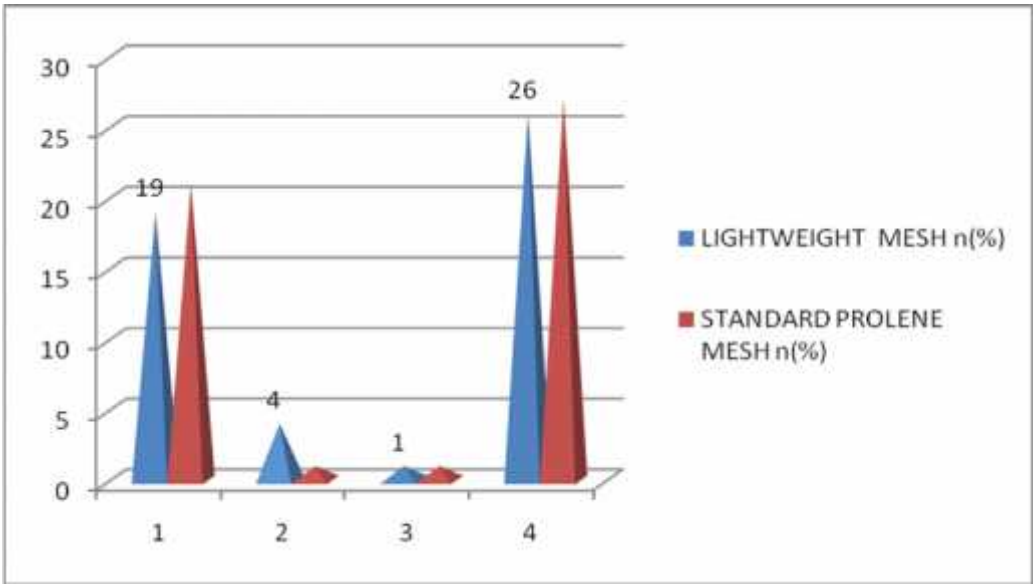


TABLE NO 8: SIDE AFFECTED

SIDE	LIGHTWEIGHT MESH n(%)	STANDARD PROLENE MESH n(%)
RIGHT	25[50]	28[56]
LEFT	21[42]	15[30]
BILATERAL	4[8]	7[14]
TOTAL	50[100]	50[100]

X^2-1.07 P-0.3010 NS

Number in parenthesis indicates percentages.

Majority no. of cases were right sided.

GRAPH NO 5

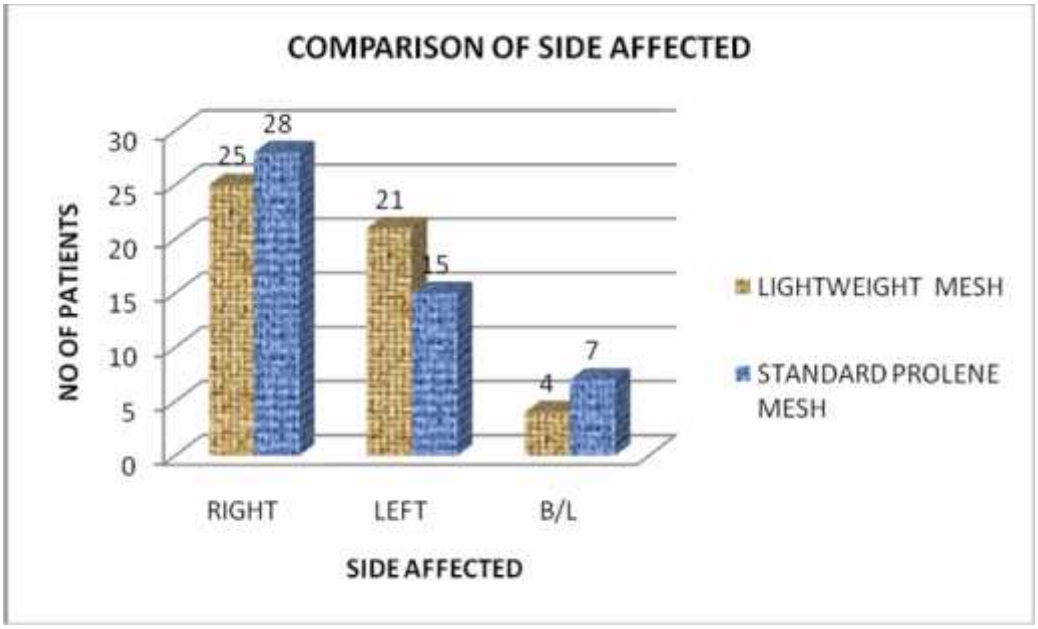


TABLE NO 9: OCCUPATIONAL STATUS

OCCUPATION	**LIGHTWEIGHT MESH n(%)**	**STANDARD PROLENE MESH n(%)**
FARMER	32[64]	22[44]
LABOURER	4[8]	9[18]
TEACHER/DOCTOR/SN	1[2]	1[2]
DRIVER/CONDUCTOR	1[2]	1[2]
STUDENT	2[4]	3[6]
RETIRED EMPLOYEE	4[8]	1[2]
BUSINESS	4[8]	8[16]
EMPLOYEE	2[4]	4[8]
POLITICAL LEADER	0[0]	1[1]
TOTAL	50[100]	50[100]

X^2-8.775 P-0.3616 NS

Number in parenthesis indicates percentages.

Farmers were more by occupation in both the groups.

GRAPH NO 6

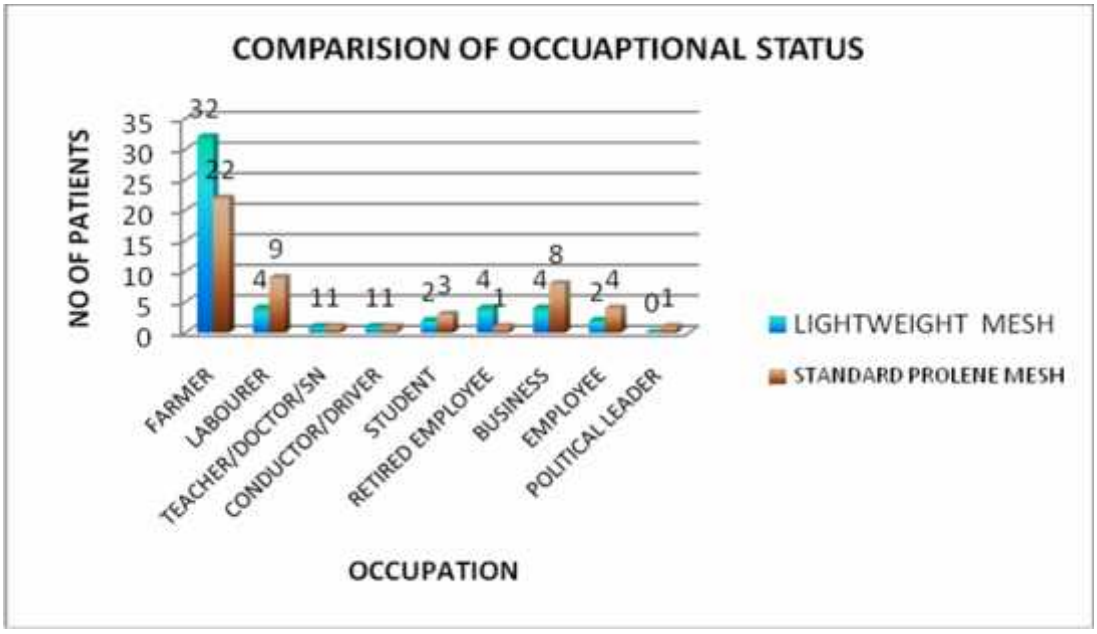


TABLE NO 10 : EXTENT OF HERNIA

	LIGHTWEIGHT MESH n(%)	STANDARD PROLENE MESH n(%)
COMPLETE	**10[20]**	**10[20]**
INCOMPLETE	**40[80]**	**40[80]**
TOTAL	**50[100]**	**50[100]**

FISCHER'S EXACT TEST P - 0.388 NS

Majority of cases were incomplete inguinal hernias in both the groups.

GRAPH NO 7

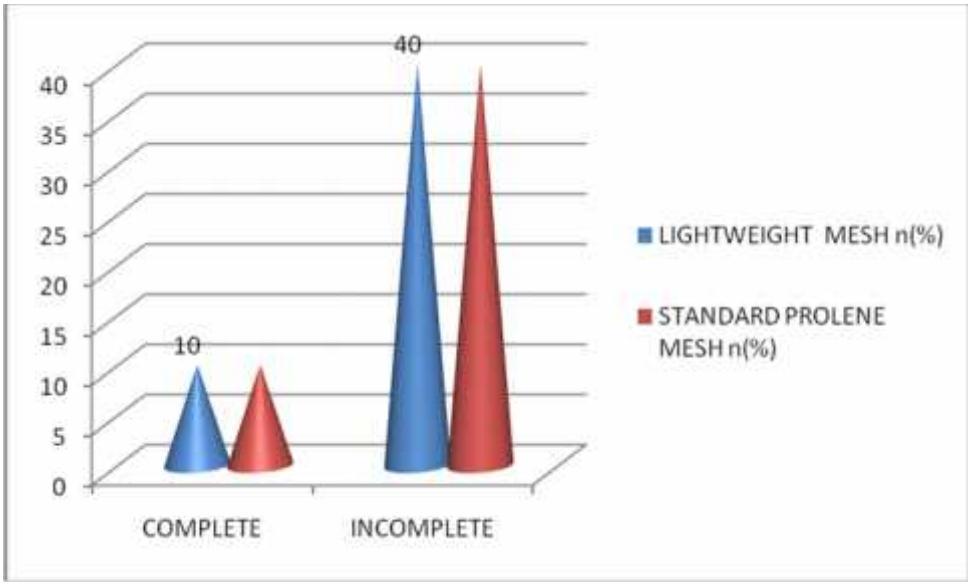


TABLE NO 11: COMPARISON OF DIRECT/ INDIRECT SAC/PANTALOON

	LIGHTWEIGHT MESH n(%)	**STANDARD PROLENE MESH n(%)**
DIRECT	23[46]	18[36]
INDIRECT	26[52]	32[64]
PANTALOON	1[2]	0[0]
TOTAL	50[100]	50[100]

X^2-2.23 P-0.3278 NS

Number in parenthesis indicates percentages

Majority no.of cases were having indirect sac.

Only one patient presented with pantaloons variety of inguinal hernia.

GRAPH NO 8

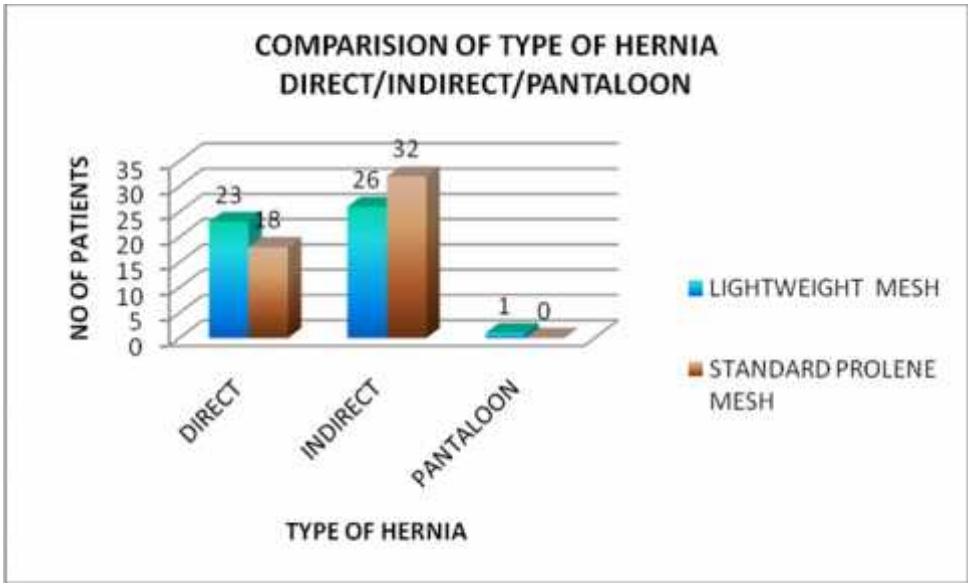


TABLE NO 12 : P E R S O N A L H I S T O R Y { H A B I T S }

HABIT	**LIGHTWEIGHT MESH n(%)**	**STANDARD PROLENE MESH n(%)**
SMOKER	12[24]	9[18]
ALCOHOL	4[8]	1[2]
TOBACCO CHEWER	5[10]	5[10]
A+S	4[8]	2[4]
A+T	1[2]	3[6]
NONE	24[48]	30[60]
TOTAL	50[100]	50[100]

X^2-4.562 P-0.4716 NS

Majority no.of patients were smokers by their habits.

GRAPH NO 9

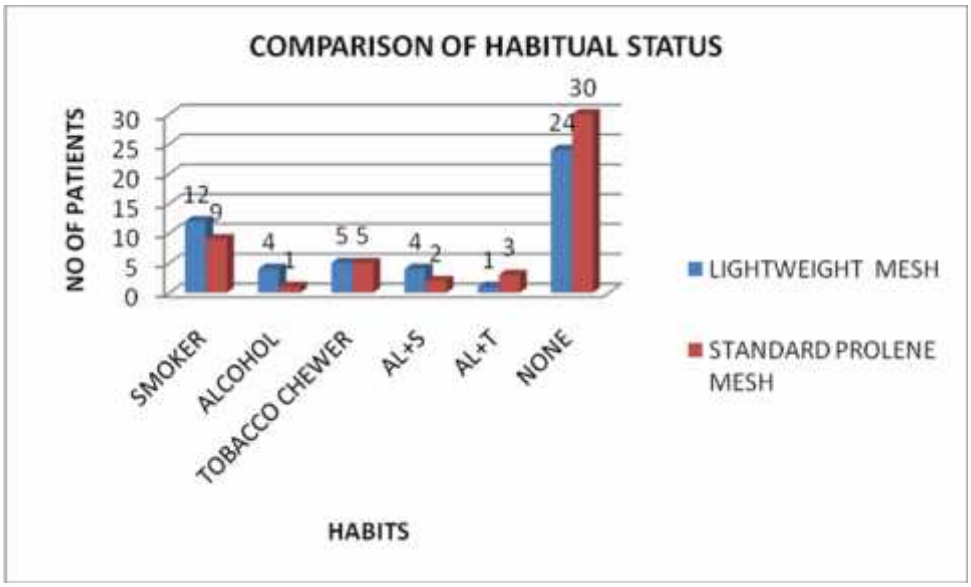


TABLE NO 13: A S S O C I A T E D I L L N E S S

	LIGHTWEIGHT MESH n(%)	STANDARD PROLENE MESH n(%)
HYPERTENSION	3[6]	1[2]
DIABETES MELLITUS	3[6]	3[6]
IHD	1[2]	1[1]
BHP	7[14]	10[20]
ASTHMA/COPD/TB	2[4]	2[4]
PARALYSIS/SPONDYLOSIS/ CONGENITAL	0[0]	2[4]
MULTIPLE	4[8]	2[4]
NONE	30[60]	29[58]
TOTAL	50[100]	50[100]

X^2-4.213 P-0.7541 NS

Number in parenthesis indicates percentages

Associated illness of BPH was more in both the groups.

GRAPH NO 10

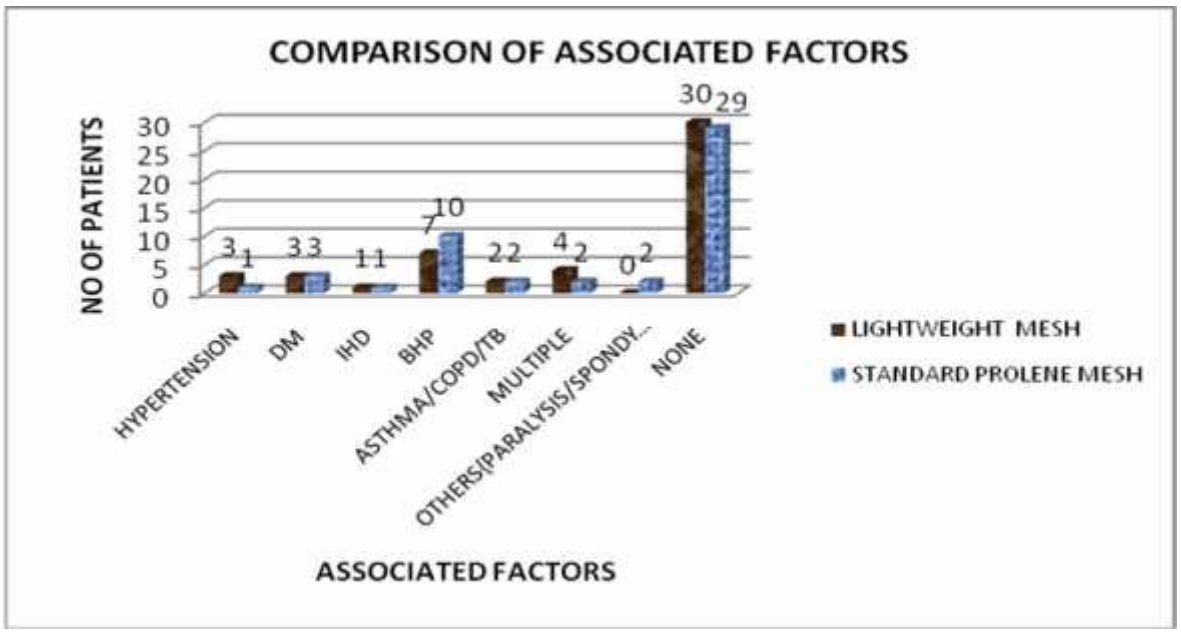


FIGURE 14 : ABDOMINAL TONE

ABDOMINAL MUSCLE TONE	LIGHTWEIGHT MESH n(%)	STANDARD PROLENE MESH n(%)
GOOD	48[96]	48[96]
POOR	2[4]	2[4]
TOTAL	50[100]	50[100]

X^2-0.00 P-1.0 NS

Malgaigne's bulgings and lax superficial ring were considered as poor abdominal muscle tone.

Only 4 patients had poor abdominal muscle tone.

GRAPH NO 11

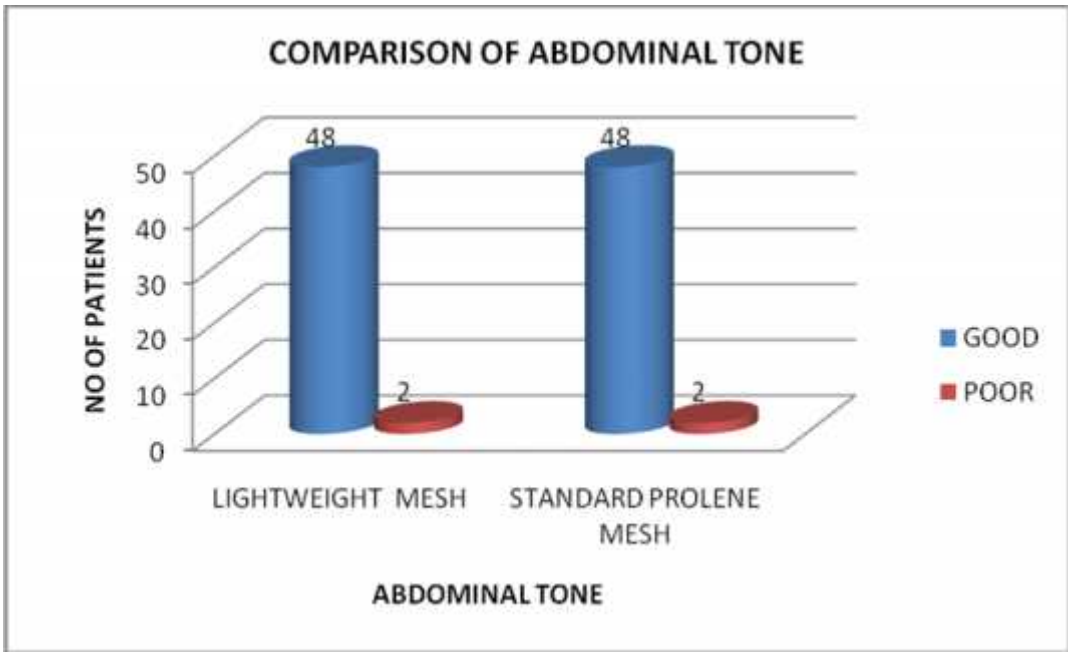


TABLE 15 : DURATION OF HOSPITAL STAY

HOSPITAL STAY	**LIGHTWEIGHT MESH n(%)**	**STANDARD PROLENE MESH n(%)**
1-3 DAYS	3[6]	4[8]
4-6 DAYS	14[28]	17[34]
7-9 DAYS	26[52]	19[38]
>9DAYS	7[14]	10[20]
TOTAL	50[100]	50[100]

X^2-2.051 P-0.5618 NS

Number in parenthesis indicates percentages

GRAPH NO 12

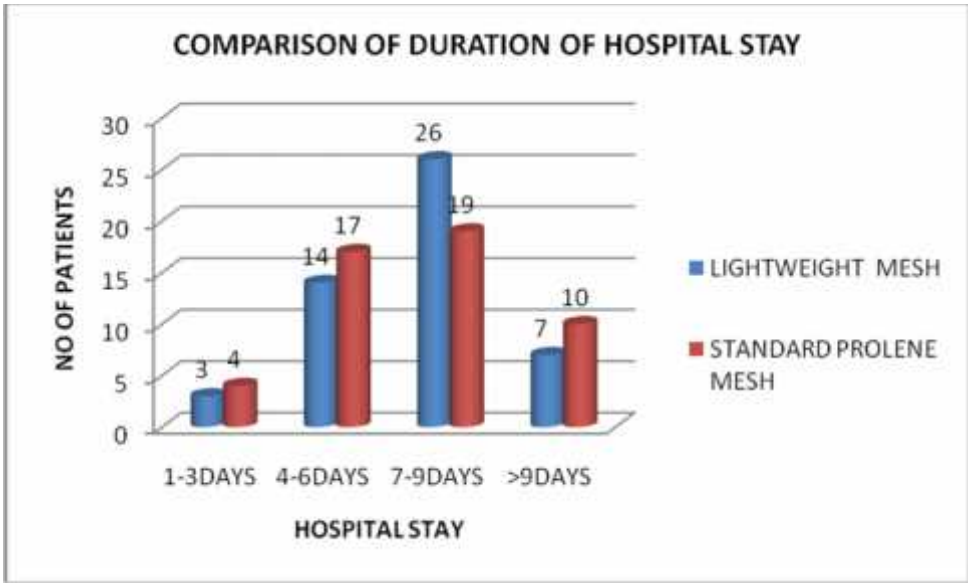


TABLE 16 : CONTENT

CONTENT	LIGHTWEIGHT MESH n(%)	STANDARD PROLENE MESH n(%)
ENTEROCELE	15[30]	19[38]
OMENTOCELE	34[68]	29[58]
BOTH	1[02]	2[04]
TOTAL	50[100]	50[100]

X^2-5.81 P-0.5486

Number in parenthesis indicates percentages

Omentocele was the content in majority of cases.

GRAPH NO 13

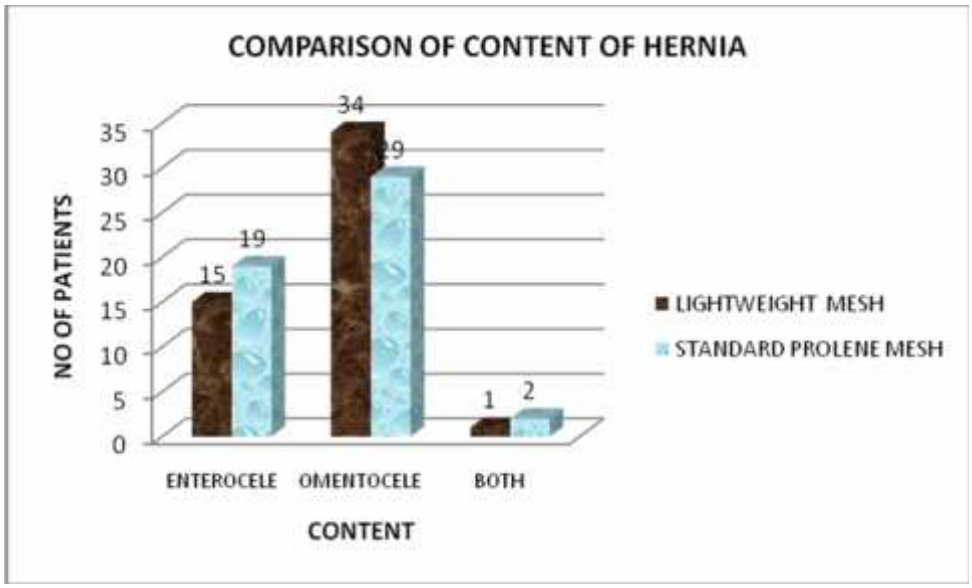


TABLE NO 17. COMPARISON OF PAIN AFTER ONE MONTH

	LIGHTWEIGHT MESH				STANDARD PROLENE MESH				P VALUE	SIGNIFICANT P VALUE <0.05
	N NO PAIN	M MILD PAIN	m MODERATE PAIN	S SEVERE PAIN	N NO PAIN	M MILD PAIN	m MODERATE PAIN	S SEVERE PAIN	<0.001	HIGHLY SIGNIFICANT
PAIN AFTER ONE MONTH	40 {80}	10 {20}	0	0	01 {2}	49 {98}	0	0		

Number in parenthesis indicates percentages

There is highly significant difference between lightweight mesh group and standard prolene mesh group with respect to pain after one month.

GRAPH NO 14

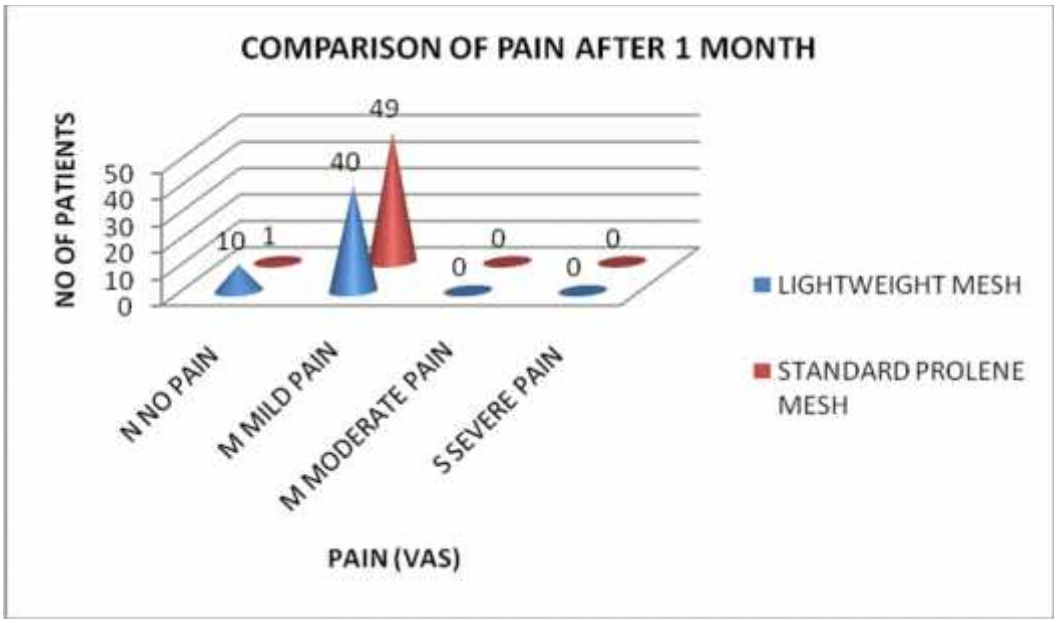


TABLE 18: COMPARISON OF SEROMA, HEMATOMA, WOUND INFECTION AFTER 1 MONTH

	LIGHTWEIGHT MESH n(%)	**STANDARD PROLENE MESH n(%)**
SEROMA	0	6[12]
HEMATOMA	0	3[6]
INFECTION	0	6[6]
NORMAL	50[100]	35[70]
TOTAL	50[100]	50[100]

Number in parenthesis indicates percentages

As there were no cases having complaints of seroma,hematoma,infection after one month of Lichtestein repair in lightweight mesh group , this group is superior than standard prolene mesh group.

TABLE 19: COMPARISON OF CHRONIC PAIN AFTER 3 MONTHS

	LIGHTWEIGHT MESH				STANDARD PROLENE MESH				P VALUE	SIGNIFICANT P VALUE <0.05
	N NO PAIN	M MILD PAIN	m MODERATE PAIN	S SEVERE PAIN	N NO PAIN	M MILD PAIN	m MODERATE PAIN	S SEVERE PAIN	<0.001	HIGHLY SIGNIFICANT
PAIN AFTER ONE MONTH	40 {80}	10 {20}	0	0	8 {16}	42 {84}	0	0		

Number in parenthesis indicates percentages

There is highly significant difference between lightweight mesh group and standard prolene mesh group with respect to chronic pain after three months.

GRAPH NO 15

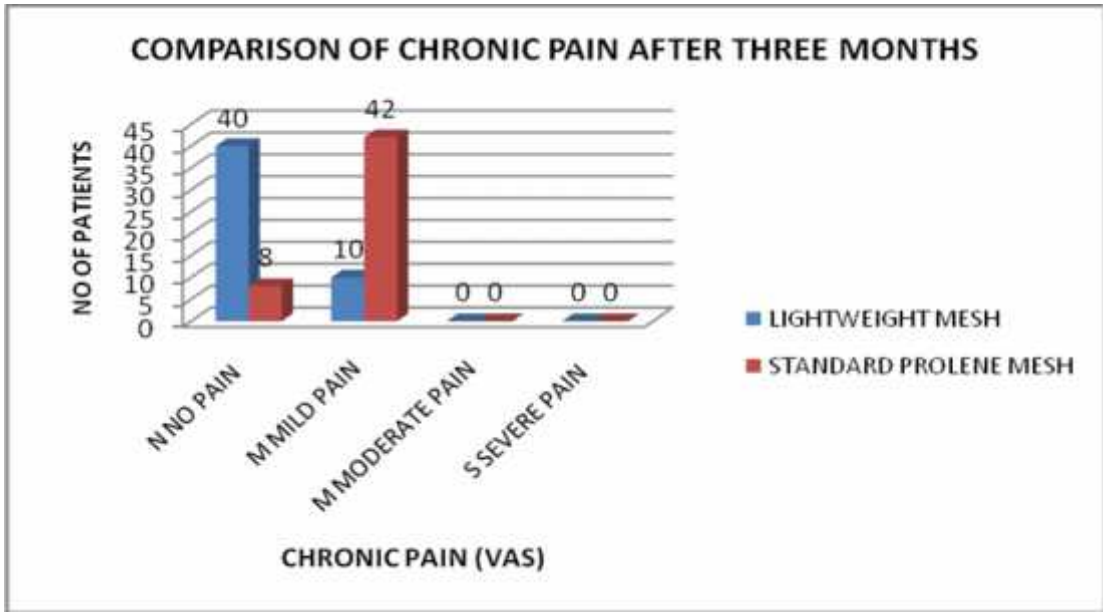


TABLE 20: FOREIGN BODY SENSATION AFTER 3 MONTHS

	YES	NO	MEAN+SD	MANN WHITMY TEST{U}	P VALUE
LIGHTWEIGHT MESH	**32{64}**	**18{36}**	**0.64ï0.4849**	**1000.0**	**0.0760 NS**
STANDARD PROLENE MESH	**42{84}**	**8{16}**	**0.84ï0.3703**		

Number in parenthesis indicates percentages

There is no significant difference between lightweight mesh group and standard prolene mesh group with respect to foreign body sensation after three months.

GRAPH NO 16

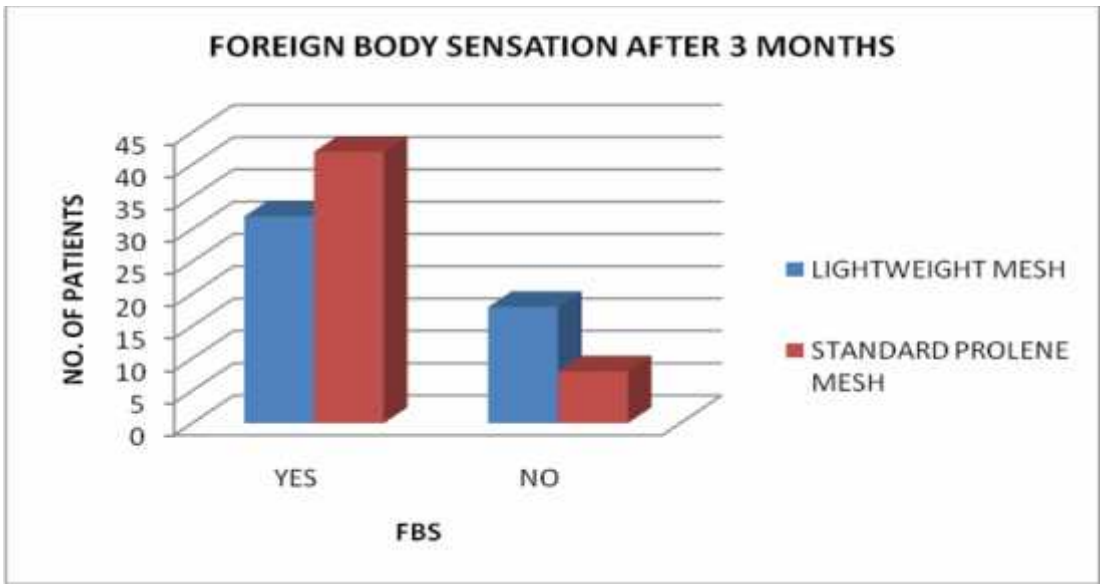


TABLE 21: COMPARISON OF TIME TAKEN TO RETURN BACK TO NORMAL ACTIVITY AFTER 3 MONTHS

	RANGE{DAYS}	MEAN+SD	MANN WHITMY TEST{U}	P VALUE
LIGHTWEIGHT MESH	7-15 DAYS	10.12ï2.173	397.00	<0.0001 HS
STANDARD PROLENE MESH	8-15 DAYS	13.64ï2.292		

There is highly significant difference between lightweight mesh group and standard prolene mesh group with respect to comparison of time taken to return back to normal activity after 3 months.

GRAPH NO 17

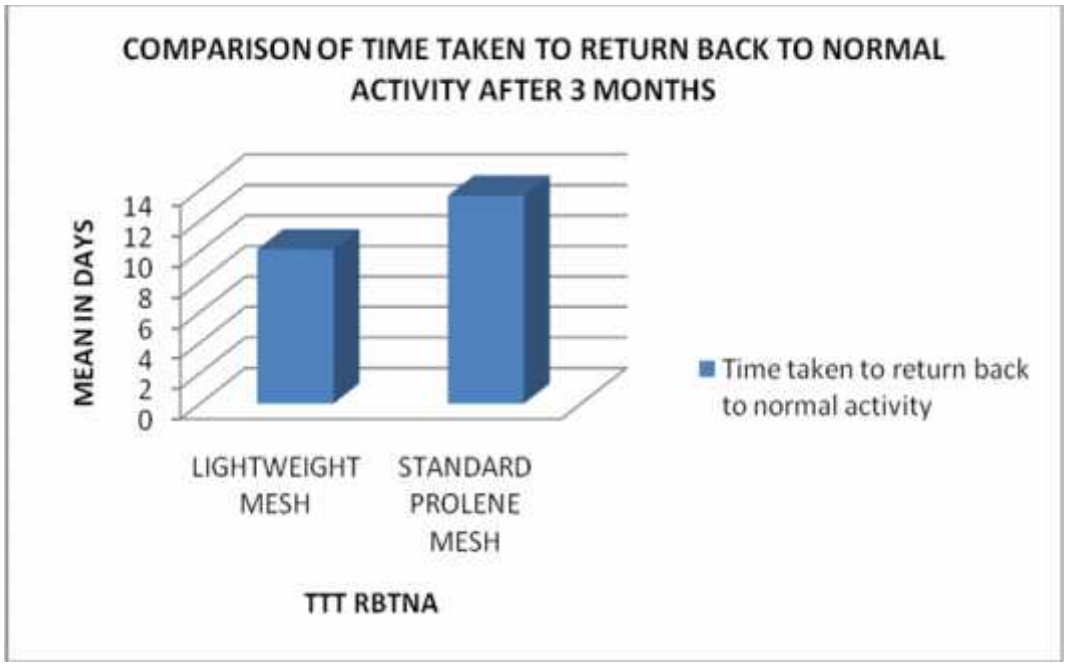


TABLE 22 : COMPARISON OF TIME TAKEN TO RETURN BACK TO NORMAL ACTIVITY AFTER 3 MONTHS{LIGHT PHYSICAL WORK OF LIFTING <10KG WEIGHT DAILY}

	RANGE{DAYS}	RETURNED BACK	NO RETURN
LIGHTWEIGHT MESH	2.5-3MTHS	3{6}	47{94}
STANDARD PROLENE MESH	0	0	50{100}

Number in parenthesis indicates percentages

As there were no patients returned back to normal activity after 3 moths ie. Light physical work of lifting <10kg daily in standard prolene mesh group , lightweight mesh group is superior with respect to comparison of time taken to return back to normal activity after 3 months{light physical work of lifting <10kg wt daily}

GRAPH NO 18

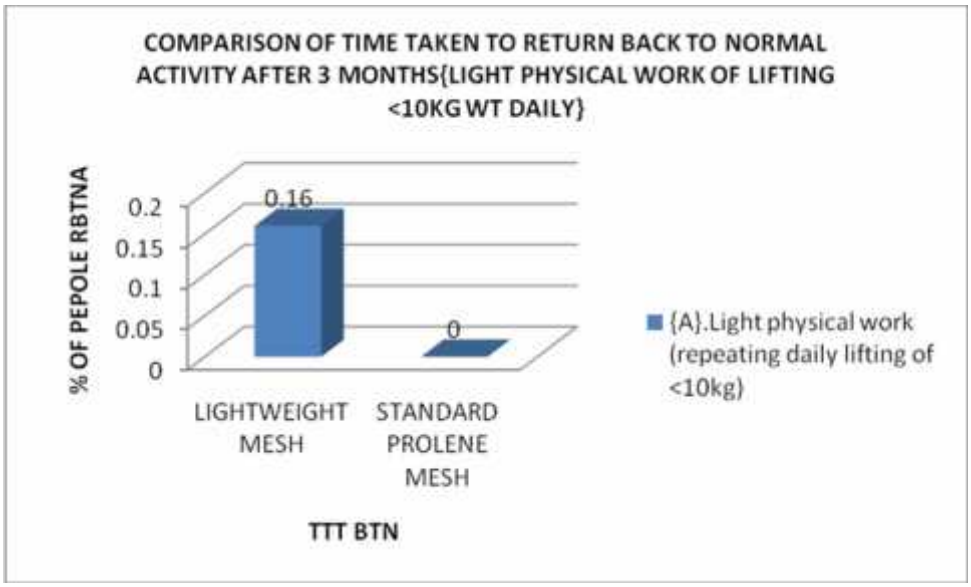


TABLE 23: COMPARISON OF CHRONIC PAIN AFTER 6 MONTHS

	LIGHTWEIGHT MESH				STANDARD PROLENE MESH				P VALUE	SIGNIFICANT P VALUE <0.05
	N NO PAIN	M MILD PAIN	m MODERATE PAIN	S SEVERE PAIN	N NO PAIN	M MILD PAIN	m MODERATE PAIN	S SEVERE PAIN	<0.001	HIGHLY SIGNIFICANT
PAIN AFTER ONE MONTH	49{98}	1{2}	0	0	27{54}	3{6}	0	0		

Number in parenthesis indicates percentages. There is highly significant difference between lightweight mesh group and standard prolene mesh group with respect to chronic pain after six months.

GRAPH NO 19

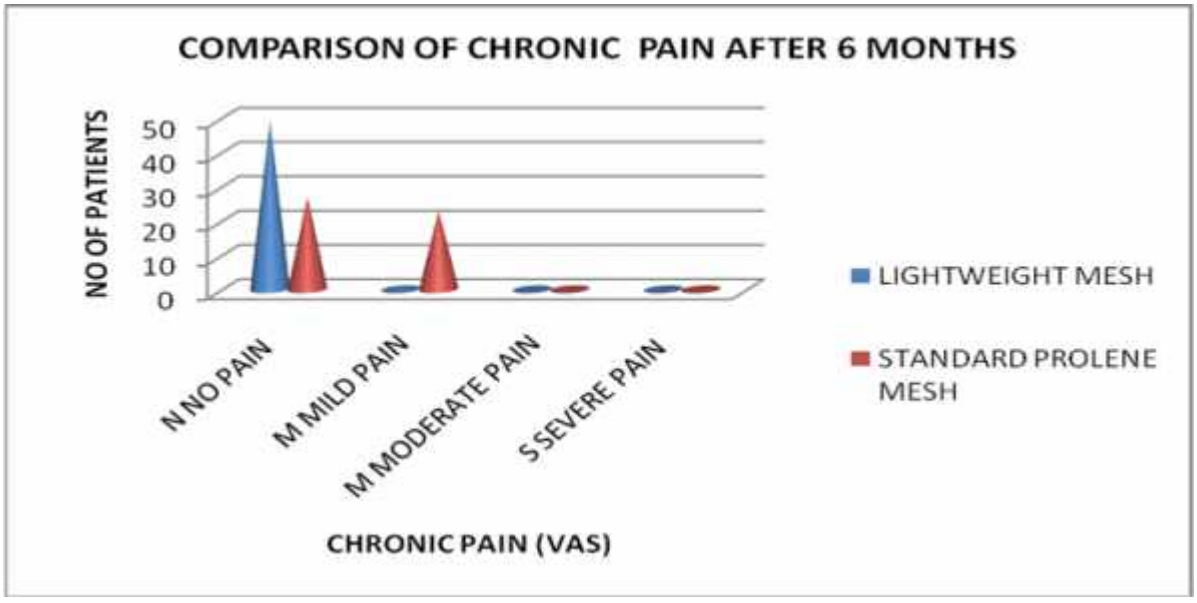


TABLE 24: FOREIGN BODY SENSATION AFTER 6 MONTHS

	YES	NO	MEANïSD	MANN WHITMY TEST{U}	P VALUE
LIGHTWEIGHT MESH	**10{20}**	**40{80}**	**0.2 ï 0.4041**		
STANDARD PROLENE MESH	**18{36}**	**32{64}**	**0.3673 ï0.487**	**1020.0**	**0.1429 NS**

Number in parenthesis indicates percentages

There is no significant difference between lightweight mesh group and standard prolene mesh group with respect to foreign body sensation after six months.

GRAPH NO 20

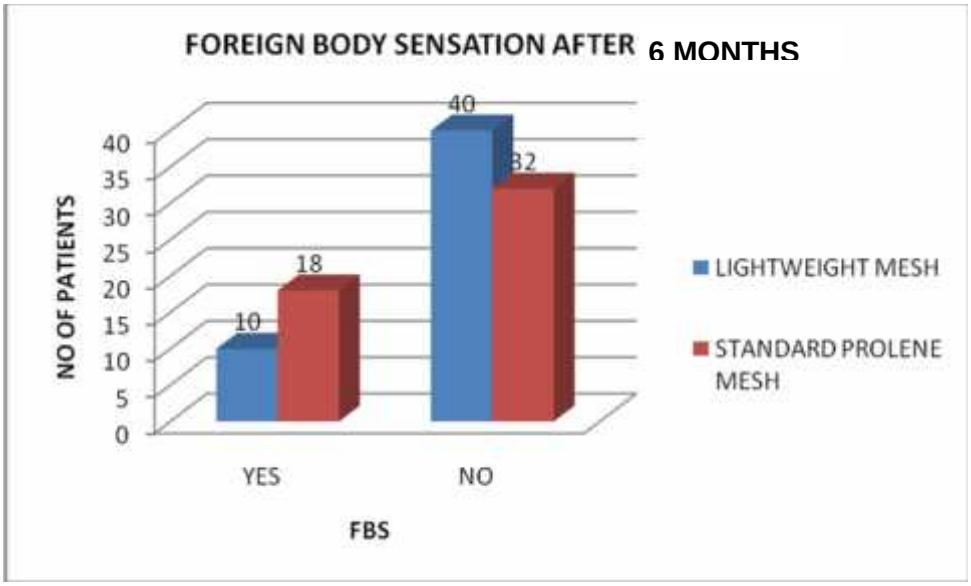


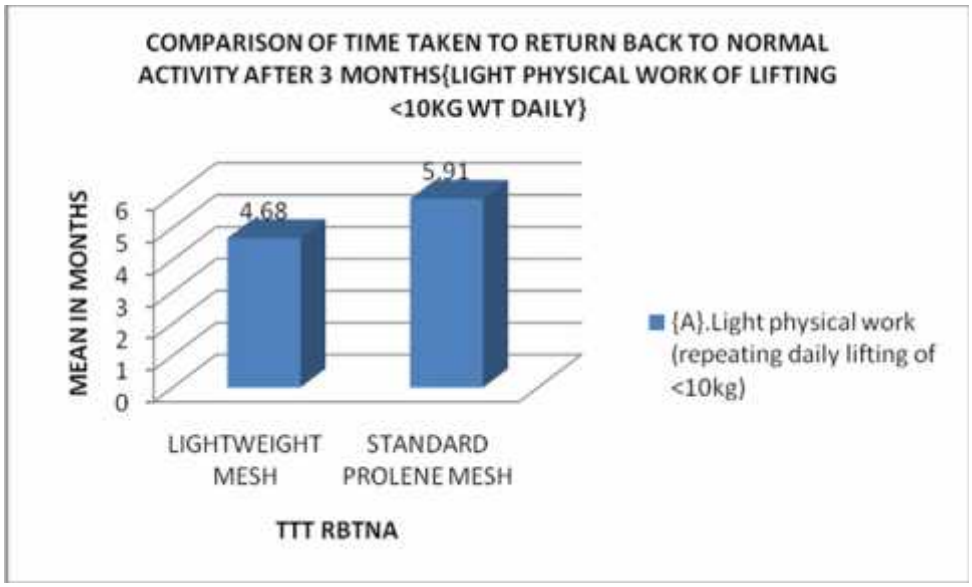
TABLE 25 : COMPARISON OF TIME TAKEN TO RETURN BACK TO NORMAL ACTIVITY AFTER 6 MONTHS{LIGHT PHYSICAL WORK OF LIFTING <10KG WT DAILY}

	RANGE{DAYS}	MEAN+SD	MANN WHITMY TEST{U}	P VALUE
LIGHTWEIGHT MESH	3.5-8 MTHS	4.68ï1.473		
STANDARD PROLENE MESH	3.5-6 MTHS	5.91ï0.9241	563.50	<0.001 HS

Number in parenthesis indicates percentages

There is highly significant difference between lightweight mesh group and standard prolene mesh group with respect to comparison of time taken to return back to normal activity after 6 months { Light physical work of lifting <10kg wt daily}

GRAPH NO 21



DISCUSSION

Inguinal hernia surgeries are one of the most frequently performed operations in general surgery and as such even minor alterations in the outcome have appreciable impact. As surgeons we want techniques with short learning curves,but we still want to attain results comparable to the specialist hernia surgeons.

Our patients on the other hand want their period of convalescence and rehabilitation to be uncomplicated in both short and long term outcome so as to return to their normal daily activities. They need less pain and better quality of life post operatively with minimum surgical morbidity in the long term.

Currently , two major techniques of hernia repair exists.

1. Pure tissue repairs

2. Tension free or mesh repairs

At present ,tension-free pre shaped mesh hernioplasties have become a gold standard for most operating surgeons and over the last decade several types of meshes have evolved, and are used as single flat meshes or used in conjunction with three dimensional plugs.

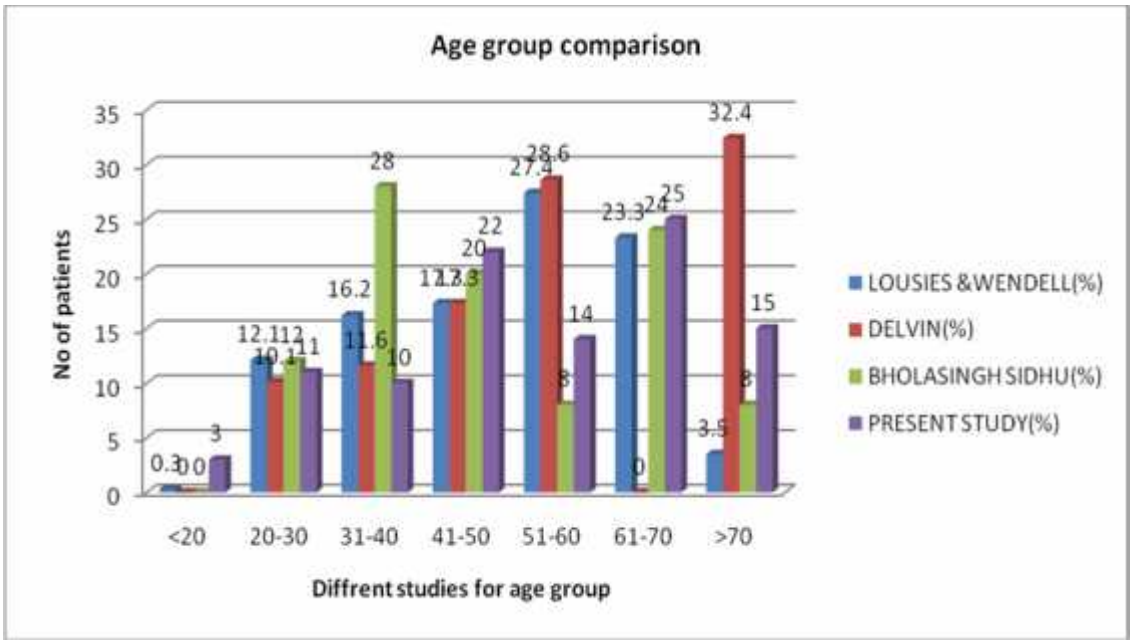
In 1984, Lichtenstein addressed the issue of tension by popularizing routine use of mesh (Monofilament polypropylene meshes) which was laid on posterior wall of the inguinal canal, and a slit made at the lateral end of the mesh, creating two tails, which pass around the cord as it emerges from the internal ring. Presently newer mesh concepts are the current interest which have less chronic pain, earlier return to normal activities without compromising on recurrence. Light weight mesh is one such concept which meets the above criteria.

The present comparative study is a small study and follow up is limited for period of 6 months. Therefore , this is a limitation of our study.

TABLE NO 26 : AGE AT PRESENTATION

AGE GROUP	LOUSIES &WENDELL[61](%)	DELVIN[58](%)	BHOLASINGH SIDHU[57](%)	PRESENT STUDY(%)
<20	0.3	-	-	3
20-30	12.1	10.1	12	13
31-40	16.2	11.6	28	15
41-50	17.3	17.3	20	20
51-60	27.4	28.6	8	14
61-70	23.3	-	24	25
>70	3.5	32.4	8	10

GRAPH NO 22



In a study by Ira 18% of cases were <15% yrs of age, 20% were 24-44 yrs, 23% were 45-65 yrs & 30% were >65 yrs; group with maximum number of cases between 25-65 Yrs of age.(Ira M Rutkow 1998).[59]

The incidence of age at presentation of inguinal hernia was maximum

between30-60 years of life (Louies & Wendell,[61] Delvin,[58] Bholla singh sidhu[57]).These results are comparable with the present study. Our study had highest no. of patients between age group of 61-70yrs and lowest in <20 yrs age group.

Sex distribution:

In study by Ira[59], 90% inguinal hernia cases were in male patients & 10% were females , study by Liechenstein[60] 94% were male patients & 6% female patients.

Occurring at any age males are more commonly affected then females.In present study 100% were male & 0% were females. The percentage of females in this study is less compared to other studies. This may be due to less awareness of women about hernia. Socio -economic & educational level of the female patients contribute to less number of female presenting to hospital with inguinal hernia in early stage in our study.

TABLE NO 27: TYPE OF HERNIA

TYPE	LOUSIES & WENDALL[61]	L PALANIVELU[62]	RHS[63]	PRESENT STUDY
INDIRECT	65%	76%	63%	58%
DIRECT	20%	24%	35%	41%

Present study group was comparable with RHS group with 58% having indirect component and 41% having direct component.

GRAPH NO 23

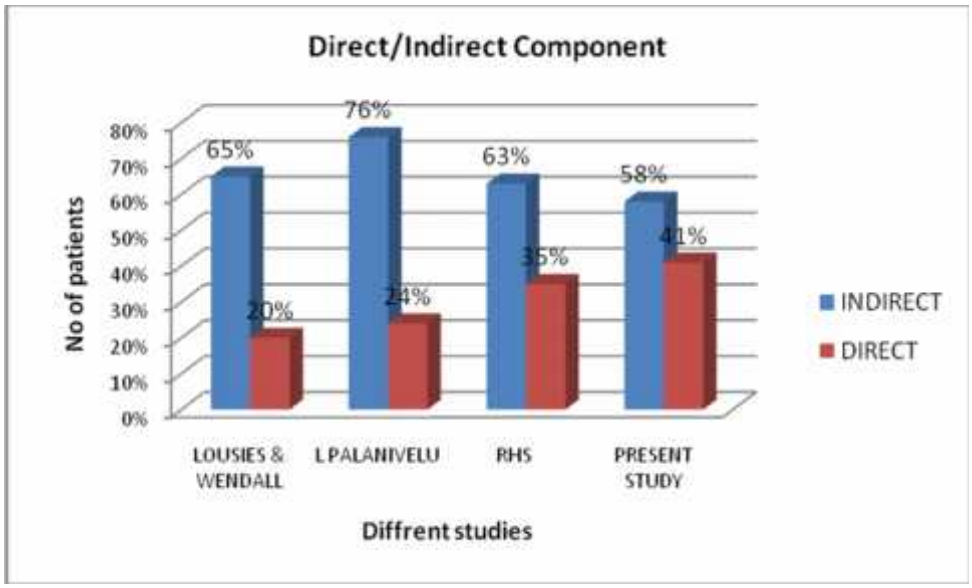
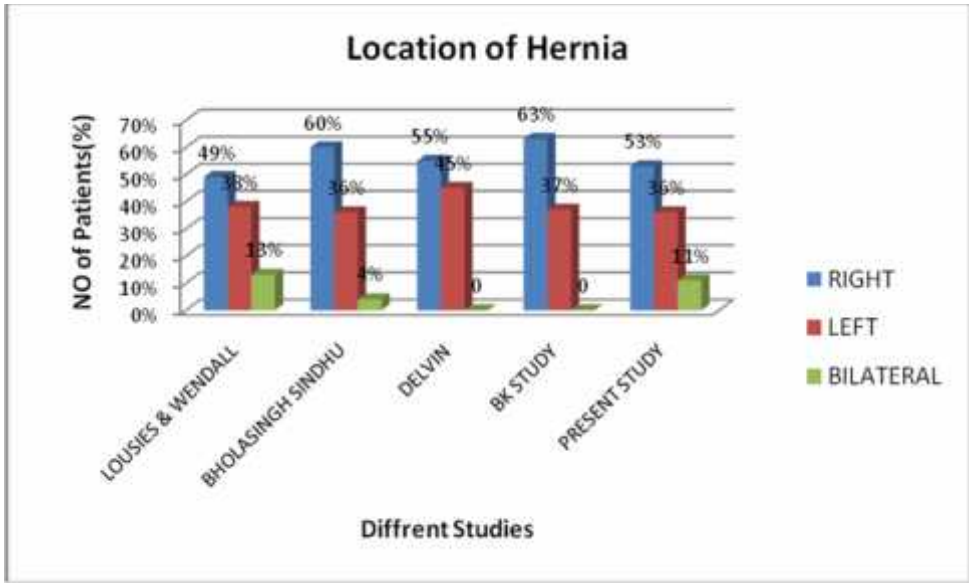


TABLE NO 28: LOCATION OF HERNIA

LOCATION	LOUSIES & WENDALL[61]	BHOLASINGH SINDHU[57]	DELVIN 58	BK STUDY[56]	PRESENT STUDY
RIGHT	49%	60%	55%	63%	53%
LEFT	38%	36%	45%	37%	36%
BILATERAL	13%	4%	-	-	11%

Present study group was comparable with Losies & Wendall group and BK study group with 53% of right sided inguinal hernias and 36% of left sided inguinal hernias and 11% having bilateral inguinal hernias.

GRAPH NO 24



Chronic pain:

Pain is difficult to measure objectively. Chronic pain following inguinal hernia repair is becoming a significant clinical problem affecting the quality of life. The exact incidence of chronic pain remains to be evaluated, varying in different series

and only a few studies presenting long term follow up and a sufficiently large study population.

In the present study, follow up of standard prolene mesh patients revealed that 01{2%} patient had no pain and 49{98%} patients had mild pain at 1 month, 08{16%} patients had no pain and 42{84%} patients had mild pain at 3 months and 27{54%} patients had no pain and 23{46%} patients had mild pain at 6 months follow up period.

Follow up of light weight mesh group patients revealed that 10{20%} patients had no pain and patients had mild pain at 1 month , 40{80%} patients had no pain and 10{20%} patients had mild pain at 3 months and 49{98%} patients had no pain at 6mths follow up period.

TABLE NO 29: PAIN COMPARED WITH OTHER STUDIES

Study	Lightweight Mesh		Study	Standard Prolene Mesh	
	Follow up	%Having Pain		Follow up	%Having Pain
S.Bringman et al[75]	3 year	0.8%	S.Bringman et al[75]	3 year	3.3%
P.J.O'Dwyer et al[76]	1 mnth 3mths	82.1% 56.8%	P.J.O'Dwyer et al[76]	1 mnth 3mths	81.8% 56.6%
M.Smieatanski et al[77]	7days 3mths 6mths 12mths	36.2% 9.8% 10.7% 3.8%	M.Smiieatanski et al[77]	7days 3mths 6mths 12mths	55.2% 17.1% 9.9% 6.2%
Present study	1mth 3mths 6mths	80% 20% 2%	Present study	1mth 3mths 6mths	98% 84% 46%

TIME TO RETURN TO NORMAL ACTIVITY:

Return to normal activities and work can be dependent on nutritional status of the patient. Malnourished patients are likely to have longer periods of convalescence.

In the present study standard prolene mesh group patients time range is 8-15 days with mean value of 13.64 days and light weight mesh group range being 7-15 days with mean value 10.12 days.

It should be noted that desk workers will usually return to work earlier than manual workers.

Time taken to return to work may also be dependent on financial incentives a patient gets at the place of work.

TABLE NO. 30: TIME TAKEN TO RETURN BACK TO NORMAL ACTIVITIES COMPARED WITH OTHER STUDIES

Study	Lightweight Mesh	Study	Standard Prolene Mesh
P.J.O'Dwyer et al[76]	21 days	P.J.O'Dwyer et al[76]	26 days
Present study	10.12 days	Present study	13.64 days

FOREIGN BODY SENSATION:

It is understood that light weight mesh with less amount of foreign body causes less foreign body reaction and thus lesser foreign body sensation.

TABLE NO 31: FOREIGN BODY SENSATION COMPARED WITH OTHER STUDIES.

Study	Lightweight mesh	Study	Standard prolene mesh
S.Bringman et al[75]	37{14.7%}	S.Bringman et al[75]	55{22.6%}
S.Post et al[74]	10{17.2%}	S.Post et al[74]	21{43.8%}
Present study After 3 mths After 6 mths	 32{64%} 10{20%}	Present study After 3 mths After 6 mths	 42{84%} 18{36%}

CONCLUSION

- Prolene Mesh is still the gold standard in mesh repair for groin hernia.
- Use of lightweight mesh for Lichtenstein hernia repair is more efficacious than regular prolene mesh and also has the potential to reduce the incidence of chronic inguinodynia and foreign body sensation.
- There is less chronic pain after 3 and 6 months in lightweight mesh repair.
- Nil cases of seroma,hematoma and infection in lightweight mesh repair.
- Earlier return to normal activities in lightweight group observed.
- Repeating daily lifting of less than 10kg is seen earlier in lightweight mesh group.
- Hence Lichtenstein tension free hernioplasty is always better option if done with lightweight mesh when compared with Lichtenstein's tension free hernia repair with standard prolene mesh.

SUMMARY

- In our study of comparison between use of lightweight mesh versus prolene mesh in Lichtenstein hernia repair, we found that out of total 100 patients ,50 in lightweight group & 50 in standard prolene group ,mean age was of 49.08 in standard prolene group & 52.74 in lightweight group.
- Patients presented with swelling in the groin with or without pain or only with pain ranging from <6 months to >5 years.
- Highest number of patients were in the age group of 60-69 years in the lightweight mesh group and in the age group of 40-49 yrs and 60-69 years in standard prolene mesh group.
- Zero females underwent Lichtestein's tension free hernioplasty.
- Majority of patients were farmers by occupation.
- Incomplete inguinal hernia was 80% in both the groups.
- There was only only pantaloon hernia reported in our study.
- Smoking was the most common associated factor in both the groups with 24% in lightweight mesh group and 18% in standard prolene mesh group.
- Majority of patients had benign hyperplasia of prostate as associated illness with 14% in lightweight mesh group and 20% in standard prolene mesh group.
- Abdominal muscle tone was poor only in 4% of the patients in both the groups.
- Pain after 1 month was seen only in 20% of patients in lightweight mesh group and whereas it was more in Standard Prolene Mesh group i.e. 98%.
- There were no cases of seroma, hematoma, infection reported in Lightweight Mesh group.

- Chronic pain was less in lightweight mesh group after 3 and 6 months of follow-up i.e. 20% and 2% respectively, whereas in standard prolene mesh group it was 84% and 6 % respectively.
- Foreign body sensation was felt only in 44% and 20% of patients in lightweight mesh group after 3 and 6 months respectively, whereas it was 84% and 36% respectively in standard prolene mesh group.
- Time taken to return back to normal activity was on an average 10.12 days in lightweight mesh group and 13.64 days in standard prolene mesh group
- Daily repeating of lifting weights <10kg- Patients returned back to work earlier in lightweight mesh group with on an average 4.68 months and control group taking 5.91 months on an average.
- So to be said in final words Lightweight Mesh is far superior option to be used in standard Lichtenstein tension free repair with only cost as hindrance factor.

BIBLIOGRAPHY

1. Ira M Rutkow. A selective history of groin hernia surgery in the early 19th century. The anatomic atlases of Astley Cooper, Franz Hesselbach, Antonio Scarpa and Jules Germain Cloquet Surgical Clinics of North America 1998; 78(6):921-940.
2. Mokete M and Earnshaw J.J. Evolution of Inguinal hernia surgery practices. Postgraduate Medical Journal, 2001; 77:189-190.
3. De MD. Hernias in history. Arch Chir Neerl 1978; 30(3):129-140
4. Irving L Lichtenstein. Hernia repair without disability: A surgical atlas illustrating the anatomy, technique and physiologic rationale of the One Day Hernia. Saint Louis: The C.V. Mosby Company, 1970; 1274-1279
5. Patino F.J. Nyhus & Condon's Hernia. A History of the treatment of hernia , part I, chapter 3, Philadelphia USA: Lippincott Williams & Wilkins; 2002; 17-28 , 5Th Edition
6. Skandalakis J.E.,Colborn G.L.,Skandalakis L.J. & McClusky III D.A. Historical aspects of groin hernia repair, Part I, Chapter 4, Nyhus & Condon's Hernia . Philadelphia USA: Lippincott Williams & Wilkins; 2002 ;29-44 , 5Th Edition
7. Gilbert A.I., Graham M F, Voigt W J. A bilayered patch device for inguinal hernia repair. Hernia. 1999; 3:161-166.
8. Anderson RA. Historical aspects of repair of inguinal hernia N C Med J 1963; 24:324-327.

9. Rousseau MA, Perdu M, Ledroux M, Delmas V (Pectineal ligament of Cooper-Micromorphometric study) morphologic 1999; 83(260):67-69

10. Read RC The centenary of Bassini's contribution to inguinal herniorrhaphy. American Journal of Surgery 1987; 153(3):324-326

11. Wexler MJ The repair of inguinal hernia 110 years after Bassini. Canadian Journal of Surgery 1997; 40(3):186-191

12. Laird EG . The evaluation of the Gallie's fascia lata repair of difficult hernias. Del Med J 1953; 25(1):3-8

13. Lee M. Indications for use of fascial grafts in repair of inguinal hernia (Gallie's operation). J Int Coll Surg1953; 19(3):290-295

14. Magarey JR the long term results of tanner's 'slide' operation for inguinal hernia. Med J Aust 1966; 1(10):392-395

15. Mc Vay CB. The anatomic basis for inguinal and femoral hernioplasty. Surg Gynecol Obstet 1974; 139(6):931-935

16. Mc Vay CB, Read RC, Ravitch MM. Inguinal hernia. Curr Probl Surg. 1967; 1-50

17. Hoffman R, Frick T, Attinger B, Platz A, Largiader F. Bassini or Shouldice operation? Helv Chir Acta 1991; 58(1-2):207-212

18. Read R.C. , Nyhus & Condon's Hernia : Why do human beings develop groin hernias ? , Part I, chapter-1, Philadelphia USA: Lippincott Williams & Wilkins; 2002; 03-08 , 5Th Edition.

19. Skandalakis John et al: “embryologic and anatomic basis of inguinal herniorrhapy” in *Surg clin NA,* Philadelphia: W.B.Sauders Co., 1993;73:799-834.
20. Skandalakis JE, Gray SW, Skandalakis LJ, et al. Surgical anatomy of the inguinal area. World J Surg. 1989; 13: 490.
21. Ponka JL. Hernias of the abdominal wall. Philadelphia: WB Saunders, 1980.
22. Garrison FH. An introduction to the history of medicine. Philadelphia: WB Saunders, 1929.
23. Kux M, Quinn T.H. - Nyhus & Condon’s Hernia, Anatomy of the groin: A view from the Surgeon & Anatomy of the groin : A view from the Anatomist, Part I, Chapter 5 & 6, Philadelphia USA: Lippincott Williams & Wilkins; 2002 ; 45-70 , 5Th Edition
24. Rosen M.J.& Malangoni M.A. Hernias.,chapter 46,Section 10 Abdomen. Sabiston Textbook of Surgery- The Biological Basis Of Modern Surgical Practice, 19th ed. W.B. Saunders, 2012; 1116{ Figure- Inguinal canal }
25. Mirilas P,McClusky III A.D.,& Skandalakis L.J.,Surgical Anatomy of the Hernial Rings. Chapter no.195,Part D: Surgery of Hernia In : Nyhus LM, Baker RJ, Fischer JE, Mastery of Surgery, 6th ed. Williams & Wilkins, 2012; 2072 { Figure- Hesselbach’s triangle}
26. Brooks D.C.,Javid P.J. Hernias. Maingot’s Abdominal operations 11th ed.,section II Abdominal wall,Chapter 5, McGraw Hill, 2007; 103-120.
27. Sherman V,Macho J.R.,Brunicardi C.. Inguinal hernias.,chapter 37, In : Schwartz’s Principles of surgery, 9th ed. McGraw Hill, 2010; 1305-1342.

28. Abrahamson Jack. Etiology and pathophysiology of primary and recurrent groinhernia formation. Surg Clin NA, 1998; 78 (6): 953-971.

29. Das S. Hernias. 7th ed. Chapter 47. In: A Concise Textbook of Surgery, Das S, ed. Calcutta, India; pp. 1120-1162.

30. Das S. A. Manual on Clinical Surgery. 10th ed. Calcutta : Dr. S. Das; June 2013 { Reprint March 2014 }, chapter no.38, Examination of a case of hernia, page no.594-610.

31. Das S. A. A Textbook on Surgical Short Cases. 4th ed. Calcutta : Dr. S. Das: June 2011,chapter no.17, Hernia, Page no.193-209.

32. Gupta RL, Textbook of Surgery. 2nd ed. New Delhi: Jaypee Brothers Medical Publishers; 2003.

33. Sinnatamby C.S. Anterior abdominal wall. Last's anatomy regional and applied, 10th ed. Churchill Livingstone, 2001{ Reprint }; 215-226.

34. Russell RCG, Williams N.S, Bulstrode C.J.K.& O'Connell P.R. Abdominal wall ,hernia & umbilicus. Chapter 60.Part 11- Abdominal, Bailey& Love's - Short practice of surgery, 26th ed. London, Arnold, 2013; 948-969

35. Williams PL, Anterior abdominal wall,Chapter 61,anterolateral muscles of the abdomen, Gray's Anatomy, 40th ed, ELBS, 2008 ; 1060-1067.

36. Chaurasia BD. Anterior abdominal wall, Human Anatomy Regional & Applied,6th ed, ,Volume-2 Lower limb,abdomen & pelvis ,CBS Publishers, 2013; 196-217.

37. Decker G.A.G., The groin & scrotum,Chapter no.10. Lee Mc Gregor's Synopsis of Surgical Anatomy. 12th ed, Varghese Publishing house,{Third Indian reprint} 1999; 118-136.
38. Rosen M.J.& Malangoni M.A. Hernias.,chapter 46,Section 10 Abdomen. Sabiston Textbook of Surgery- The Biological Basis Of Modern Surgical Practice, 19th ed. W.B. Saunders, 2012; 1114-1140.
39. Rutkow IM. Surgical operations in the United States Arch Surg. 1997; 132: 983.
40. Mirilas P,McClusky III A.D.,& Skandalakis L.J.,Surgical Anatomy of the Hernial Rings. Chapter no.195,Part D: Surgery of Hernia In : Nyhus LM, Baker RJ, Fischer JE, Mastery of Surgery, 6th ed. Williams & Wilkins, 2012; 2061-2084.
41. Das S. A manual on clinical surgery. 10th ed. Calcutta : Dr. S. Das; June 2013 { Reprint March 2014 }, chapter no.38, Examination of a case of hernia, page no.603-606
42. Clain A. Demonstration of physical signs in clinical surgery. 17th ed. 1992; 260-272.
43. Browse NL. An introduction to the symptoms and signs of surgical diseases. 2nd ed. ELBS, 1991; 310-321.
44. Rutkow IM, Robbins AW. Hernia repair : the mesh plug hernia repair. In : Carter D, Russel RCG, Pitt HA, Atlas of General Surgery, 3rd ed. London. Arnold, 1996; 59-67.

45. Epidemiology statistics available on the website bestpractice.bmj.com/best-practice/monograph/723/basics/epidemiology.html. and study conducted by Asia Pacific Hernia Society on hernia statistics at website www.aphernia.com/herniastatistics.htm.

46. Vadim Sherman, James R. Macho, and F. Charles Brunicardi. 9th edition Chapter 37 inguinal hernias, Schwartz's principles of surgery. F. Charles Brunicardi ed. Mc Graw Hill medical: 1318-1323.

47. Zollinger Sr R.M, Zollinger Jr.R.M: repair of inguinal hernia with mesh. Chapter 50. Zollinger's atlas of surgical operations, 8th edn, 2003; 412-431

48. Amid P.K, Lichtenstein Tension- Free Hernioplasty for the Repair of Primary and Recurrent Inguinal Hernias : Nyhus & Condon's Hernia, Part II ,Chapter 14, Philadelphia USA: Lippincott Williams & Wilkins; 2002; 149-158 , 5Th Edition

49. Stephen j Nixon, Bruce Tulloh (2013) abdominal wall, hernia and umbilicus, In: Norman S. Williams, Christopher J.K.Bulstrode, P. Ronan O'Connell(Ed) BAILEY & LOVE'S Short practice of Surgery, 26th edn. CRC Press, pg948-969

50. A. Coda, R. Lamberti, S. Martorana: Classification of prosthetics used in hernia repair based on weight and biomaterial. Hernia. DOI 10.1007/s10029-011-0868-z

51. Schumpelick V, Klinge U. & Klosterhalfen B.,Biomaterials for the reapair of Abdominal Wall Hernia : Structural and Compositional Considerations, In: Nyhus & Condon's Hernia, Part VIII, Chapter 47, Philadelphia USA: Lippincott Williams & Wilkins; 2002 ; 551-566 , 5Th Edition

52. P.K. Amid: Classification of biomaterials and their related complications in abdominal wall hernia surgery. Hernia (1997) 1:15-21.

53. Maximo Deysine, pathophysiology, prevention, and management of prosthetic infections in hernia surgery. The Surgical Clinics of North America vol 78, No. 6, Dec 1998. Pg1105-1114.

54. Andrew Welsh(Ed) Surgical site infection: prevention and treatment of surgical site infection Oct 2008. National Collaborating Centre for Women's and Children's Health.

55. Garner JS, Favero MS. CDC guidelines for the prevention and control of nosocomial infections. Guideline for hand washing and hospital environmental control, 1985. Am J Infect Control 1986; 14:110–29.

56. Bahader kulah et al 2001. Presentation & outcome of incarcerated external hernia's in adults.American Journal of surgery Vol 181: 101-104.

57. Bholla Singh Sidhu et al 1999. Tension free Hernioplasty under local anaesthesia Gilbert repair. Indian journal of surgery Vol 61: 310-314.

58. .Delvin H, Brenden: Management of abdominal hernias , London ; ButterWorths & company Ltd 1988,220p.

59. Ira M Rutkow 1998 .Epidemologic , economic & sociologic aspects of hernia surgery in the united states in the 1990's. Surgical clinics of north America Vol78. No 6:941-951.

60. Irving L Lichtenstien 1987 .Herniorrhaphy, A personal experience with 6321 cases.American journal of surgery. Vol 153 : 553-559.

61. .Meier , Albert E . Surgical clinics of North America- symposium on surgery of hernia , Philadelphia , W B saunders Co 1971 Vol 51, 1249-1254.

62. Pande D P et al 1996. Collagen pattern study in Fascia Transversalis of hernia patients .Indian journal surgery july- aug :229-231.

63. Raymond C Read .Historical surgery of treatment of hernia. Chapter 1 hernia Nyhus & Condon's Hernia Philadelphia USA: Lippincott Williams & Wilkins; 2002 , 5Th Edition

64. Debord JR. The historical development of prosthetics in Hernia surgery. Surg Clin North Am 1998;78{6}:973.79

65. schumpehck V,Klinge U,Klosterhalfen B. Biomaterials for the repair of abdominal wall hernia ;structural and compositional considerations. Chapter 47,In: Fitgibbons R, Greenberg G,editors. Nyhus and Condon's Hernia ,5th edn, Philadelphia USA: Lipincott Williams and Wilkins,2002.p 551-565

66. .Martin K, Belsham PA,Klark AE. The Lichtenstein's repair. Surg clin North Am 1998;78{6}:1025-1046

67. Klinge U. Mesh for hernia repair. Br J Surg 2008;95:539-540

68. David.E, Lisa.M. Prosthetic material in inguinal repair: How do I Choose? Surgical clinics of North America 88 (2008); p 179-201.

69. Palanivelu C.operative manual of laparoscopic hernia surgery. GEM foundation 1st edition 2004 .page 22

70. Sharon. B, Bruce R.Prosthetic Material in Ventral Hernia Repair: How do I choose ? Surgical clinics of North America 88 (2008); p 101-112.

71. .Klosterhalfen.B, Karsten.J, Klinge.U. The Lightweight and large porous mesh concept for hernia repair. www.future-drugs.com.

72. Silvestre AC,de Mathia GB,Fagundes DJ,Medeiros LR,Rosa MI.Shrinkage evaluation of heavyweight and lightweight polypropylene meshes in inguinal hernia repair: a randomized controlled trial. In Hernia.2011 Dec;15{6}:629-34

73. Uzzaman MM, Ratnasingham K,Ashraf N. Meta-analysis of randomized controlled trials comparing lightweight and heavyweight mesh for Lichtenstein inguinal hernia repair.Hernia .2012 Oct;16{5}:505-18

74. Post.S, Weiss.B, Willer.M, Neufang.T, Lorenz.D, Randomized clinical trial of Lightweight composite mesh for Lichtenstein Hernia Repair. British journal of Surgery 2004; 91:44-98.

75. Bringman.S, Wollert.S, Osterberg.J, Smedberg.S, Granlund.H, Heikkinen.T. Three-year results of a randomized clinical trial of Lightweight or standard Prolene mesh in Lichtenstein repair of Primary inguinal hernia. British journal of Surgery 2006; 93: 1056-1059.

76. P.J.O'Dwyer,A.N.Kingsworth,R.G.Molloy,P.K.Smal,B.Lammers and G.Horeyseck.Randomized clinical trial assessing impact of lightweight or heavyweight mesh on chronic pain after inguinal hernia repair.In British Journal of Surgery 2005;92:166-170

77. M.Smietanski for the Polish Hernia study group . Randomised clinical trial comparing Polypropylene with a poliglecaprone and polypropylene composite mesh for inguinal hernioplasty.In British Journal of Surgery 2008;95:1462-1468.

ANNEXURE

B.L.D.E. UNIVERSITY'S
SHRI.B.M.PATIL MEDICAL COLLEGE, BIJAPUR-586 103
INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 18-10-2012 at 3-30pm to scrutinize the Synopsis of Postgraduate Students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected & revised version synopsis of the Thesis has been accorded Ethical Clearance.

Title "Comparative study between light weight mesh versus Standard prolene mesh in lichtensteins hernia repair"

Name of P.G. student Dr. Sunil Kumar
Surgery

Name of Guide/Co-investigator Dr. M.B. Patil
Prof of Surgery

DR.TEJASWINI. VALLABHA
CHAIRMAN
INSTITUTIONAL ETHICAL COMMITTEE
BLDEU'S, SHRI.B.M.PATIL
MEDICAL COLLEGE, BIJAPUR.

Following documents were placed before E.C. for Scrutinization
1) Copy of Synopsis/Research project.
2) Copy of informed consent form
3) Any other relevant documents.

SAMPLE INFORMED CONSENT FORM

B.L.D.E.U's SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, BIJAPUR – 586103, KARNATAKA.

TITLE OF THE PROJECT:

COMPARATIVE STUDY BETWEEN LIGHTWEIGHT MESH VS STANDARD PROLENE MESH IN LICHTENSTEN HERNIA REPAIR.

PRINCIPAL INVESTEGATOR: Dr. SUNILKUMAR
Department of General Surgery
Email:dkdrsunil0@gmail.com

PG GUIDE: Dr. M.B. Patil M.S.
Professor of Surgery
B.L.D.E. University's
Shri B.M. Patil Medical College Hospital & Research Centre, Sholapur Road, BIJAPUR - 586103

PURPOSE OF RESEARCH:

I have been informed that this study will analyse comparative study between light weight mesh versus standard prolene in Lichtenstein hernia repair.

I have been explained about the reason for doing this study and selecting me/my ward as a subject for this study. I have also been given free choice for either being included or not in the study.

PROCEDURE:

I understand that relevant history will be taken. I will undergo detailed clinical examination after which necessary investigations will be done whenever required, which would help the investigator for appropriate management.

RISKS AND DISCOMFORTS:

I understand that I/my ward 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 is not expected to exaggerate these feelings which are associated with the usual course of treatment.

BENEFITS:

I understand that I/my wards participation in this study will help to analyse the effectiveness of light weight mesh in reducing post operative complications.

CONFIDENTIALITY:

I understand that medical information produced by this study will become a part of this Hospital records and will be subjected to the confidentiality and privacy regulation of this 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 purpose, no names will be used and other identifiers such as photographs and audio or video tapes will be used only with my special written permission. I understand that I may see the photograph and videotapes and hear audiotapes before giving this permission.

REQUEST FOR MORE INFORMATION:

I understand that I may ask more questions about the study at any time. Dr. SUNIL KUMAR 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 this 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 and that a copy of this consent form will be given to me for careful reading.

REFUSAL OR WITHDRAWL OF 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. SUNIL KUMAR will 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 therapist, if this is appropriate.

INJURY STATEMENT:

I understand that in the unlikely event of injury to me/my ward, resulting directly to my participation in this study, if such injury were reported promptly, then medical treatment would be available to me, but no further compensation will 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 _____ the purpose of this research, the procedures required and the possible risks and benefits, to the best of my ability in patient's own language.

Date: Dr. M.B. PATIL (Guide) Dr. SUNIL KUMAR (Investigator)

STUDY SUBJECT CONSENT STATEMENT:

I confirm that Dr. SUNIL KUMAR has explained to me the purpose of this research, the study procedure that I will undergo and the possible discomforts and benefits that I may experience, in my own language.

I have been explained all the above in detail in my own language and I understand the same. Therefore I agree to give my consent to participate as a subject in this research project.

_____

(Participant) Date

_____

(Witness to above signature) Date

PROFORMA

CASE NO:

1. Name : IP No :
2. Age/sex: DOA:
3. occupation DOS:

Address: DOD:

4. CHIEF COMPLAINTS:

Swelling in the inguinoscrotal region:

- Onset
- Duration
- Progress
- Size and extent when appeared
- Aggravating factors
- Relieving factors

Pain in the inguinal region :

- Mode of onset
- Duration
- Character
- Aggravating factors
- Relieving factors

Risk factors:

- Chronic cough
- Smoking
- Constipation
- Difficulty in passing urine

Past history:

5. Personal history:

- Diet
- Appetite
- Bowel/Bladder
- Sleep
- Habits

6. Family history

7. GENERAL PHYSICAL EXAMINATION:

1. Obese / Not Obese
2. Nutritional status: Poor / Average / Good
3. Pallor
4. Icterus
5. Cyanosis / Clubbing
6. General – Lymphadenopathy
7. PR
8. BP

Systemic examination

Per Abdomen:

Inspection

1. Abdominal obesity
2. Swelling – size
3. Shape
4. Position & Extent
5. Skin over the swelling
6. Expansile impulse on coughing
7. Visible Intestinal Peristalsis

Palpation:

1. Tenderness
2. Local rise in temperature
3. Size
4. Shape
5. Position and Extent
6. To get above the swelling
7. Shape and size of defect
8. Consistency
9. Content
10. Reducibility
11. Invagination test
12. Ring occlusion test
13. Ziemann's test

14. Abdominal tone: Straight Leg Raising test and Neck raising test

Percussion: Dull / Resonant

Auscultation: Bowel sounds

Per Rectal Examination:

Chronic constipation

Enlarged prostate

Respiratory System:

Inspection

Palpation

Percussion

Auscultation

Cardiovascular System:

Inspection

Palpation

Percussion

Auscultation

Central Nervous System:

Higher Mental functions

Diagnosis

INVESTIGATIONS:

- Hb TC DC
- Blood Grouping & Rh Typing
- Blood Urea, Serum Creatinine
- RBS
- Urine analysis
- ECG
- Chest X-ray

Management

Preoperative treatment

1) Correction of anaemia.
2) Weight reduction if obese.
3) Improvement of nutritional status.
4) Treatment of respiratory infection if any.

5) Abstinence from smoking / alcohol.

6) Advice regarding breathing exercises.

Operative procedure

Type of surgery

Anaesthesia GA / SA

Prophylactic antibiotic

Drains

Post operative period

Pain

Respiratory infection

Wound infection

Paralytic ileus

Drain removal

Suture removal

Follow up at : 1month

3months

6months

Inference:

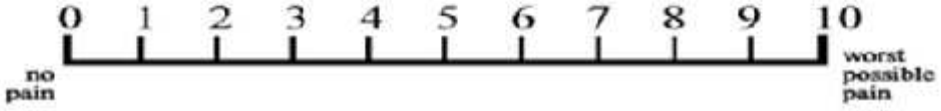
Comments:

VISUAL ANALOG SCALE (VAS)

Faces Pain Scale

0	2	4	6	8	10
Very happy, no hurt	Hurts just a little bit	Hurts a little more	Hurts even more	Hurts a whole lot	Hurts as much as you can imagine (don't have to be crying to feel this much pain)

Visual Analog Scale (VAS)



COMPARATIVE STUDY BETWEEN LIGHT WEIGHT MESH VERSUS STANDARD PROLENE MESH IN LICHTENSTEINS HERNIA REPAIR

1} Follow-up After One Month

Pain – Visual Analog Scale {VAS} Score –

Seroma – Yes / No

Hematoma – Yes / No

Infection – Yes / No

2} Follow-up After Three Months

Chronic pain - Visual Analog Scale {VAS} Score –

Foreign body sensation – Yes / No

Time taken to return back to normal activity –

Light physical work { Repeating daily lifting of less than 10kg } –

3} Follow-up After Six Months

Chronic pain – Visual Analog Scale {VAS} Score –

Foreign body sensation – Yes / No

Time taken to return back to normal activity –

Light physical work { Repeating daily lifting of less than 10kg } –

KEY TO MASTERCHART

SL NO	-	SERIAL NUMBER
M	-	MALE
IP NO	-	IN PATIENT NUMBER
DOA	-	DATE OF ADMISSION
DOS	-	DATE OF SURGERY
DOD	-	DATE OF DISCHARGE
Y	-	YES
N	-	NO
VAS	-	VISUAL ANALOGUE SCALE

Master Chart Group - I (LIGHTWEIGHT MESH)

								FOLLOW-UP AFTER 1 MONTH				FOLLOW-UP AFTER 3 MONTHS				FOLLOW-UP AFTER 6 MONTHS			
Sl. No	NAME	AGE IN YEARS	SEX	IP NO	DOA	DOS	DOD	PAIN (VAS SCORE 0-10)	SEROMA (Y-1, N-0)	HEMATOMA (Y-1, N-0)	INFECTION (Y-1, N-0)	CHRONIC PAIN (VAS SCORE 0-10)	FOREIGN BODY SENSATION (Y-1, N-0)	TIME TAKEN TO RETURN BACK TO NORMAL ACTIVITY (DAYS)	LIGHT PHYSICAL WORK{REPEATING DAILY WEIGHT OF <10KG} (MONTHS)	CHRONIC PAIN (VAS SCORE 0-10)	FOREIGN BODY SENSATION (Y-1, N-0)	TIME TAKEN TO RETURN BACK TO NORMAL ACTIVITY (DAYS)	A.LIGHT PHYSICAL WORK {REPEATING DAILY LIFTING OF LESS THAN 10KG} (MONTHS)
1	Hanmantappa	45	M	23657	10/18/2012	10/20/2012	10/27/2012	1				1	0	12	2.5	1	0		0
2	Mahantayya	39	M	26499	11/19/2012	11/21/2012	11/29/2012	2				2	0	10			0		3.5
3	Tippanna	55	M	26500	11/19/2012	11/21/2012	11/29/2012	2				0	1	15			0		4
4	Sharanappa	41	M	26955	11/23/2012	11/25/2012	12/1/2012	2				0	1	12			1		6
5	Basangouda	78	M	27793	11/30/2012	12/1/2012	12/5/2012	2				1	0	10			0		6
6	Kashimsab	65	M	28620	12/6/2012	12/8/2012	12/20/2012	1				0	1	10			1		5
7	Neelkanthray	35	M	29042	12/11/2012	12/13/2012	12/20/2012	2				0	1	10			1		6
8	Nathobha	65	M	29018	12/11/2012	12/18/2012	12/25/2012	2				0	1	12			1		6
9	Hanmanthraya	30	M	29578	12/17/2012	12/19/2012	12/27/2012	0				0	1	8			0		3.5
10	Siddappa	80	M	1888	1/21/2013	1/23/2013	2/1/2013	2				0	1	15			1		5.5
11	Prakash	29	M	2915	2/1/2013	2/2/2013	2/7/2013	2				0	1	8			1		4
12	Basawaraj	62	M	3889	2/11/2013	2/12/2013	2/16/2013	3				2	1	11			1		6
13	Hanmant	48	M	4787	2/20/2013	2/22/2013	3/1/2013	2				0	1	10			1		3.5
14	Basappa	60	M	5225	2/25/2013	3/1/2013	3/5/2013	2				0	1	10	3		1		0
15	Laxman	71	M	6833	3/12/2013	3/14/2013	3/22/2013	2				0	1	12			1		4
16	Shivappa	50	M	7257	3/15/2013	3/19/2013	3/26/2013	2				0	1	9			0		5
17	Yallappa	70	M	7469	3/16/2013	3/18/2013	3/26/2013	4				2	1	15			0		6
18	Mahadev	42	M	8467	3/26/2013	3/28/2013	4/5/2013	2				0	1	10			0		6
19	Babu	60	M	8548	3/27/2013	3/29/2013	4/5/2013	1				0	1	12			0		5.5
20	Kallappa	80	M	9003	4/1/2013	4/3/2013	4/9/2013	3				2	1	15			0		6
21	Sharanappa	55	M	9010	4/1/2013	4/3/2013	4/10/2013	2				0	1	8			0		6
22	Basagond	68	M	10624	4/16/2013	4/17/2013	4/26/2013	2				0	0	10			0		6
23	Shanmukhayya	27	M	12340	5/4/2013	5/7/2013	5/10/2013	0				0	0	8			0		4
24	Basappa	45	M	12460	5/6/2013	5/8/2013	5/16/2013	2				0	0	10			0		6
25	Veerbhadrayya	65	M	13032	5/13/2013	5/15/2013	5/22/2013	2				0	0	10			0		5.5
26	Rajashekhar	65	M	14608	5/29/2013	5/30/2013	6/1/2013	3				2	1	15			0		6
27	Shivanandayya	32	M	15573	6/7/2013	6/10/2013	6/13/2013	0				0	0	8	2.5		0		0
28	Shivaputrappa	47	M	17771	6/28/2013	6/29/2013	7/4/2013	2				0	1	8			0		4
29	Vitthal	24	M	22150	8/12/2013	8/14/2013	8/17/2013	2				0	0	10			0		4.5
30	Shrimanth	65	M	25515	9/12/2013	9/14/2013	9/23/2013	2				0	1	10			0		6
31	Mallappa	18	M	29255	10/21/2013	10/23/2013	10/31/2013	2				0	1	10			0		5
32	Ramu	25	M	1213	11/17/2013	11/23/2013	11/28/2013	2				0	1	10			0		4.5
33	Shivamurti	65	M	4381	12/18/2013	12/20/2013	12/30/2013	3				2	1	12			0		6
34	Sangamesh	41	M	4480	12/19/2013	12/21/2013	12/30/2013	0				0	0	8			0		5.5
35	Irappa	40	M	1029	1/10/2014	1/13/2014	21-012014	0				0	1	10			0		4
36	Shreemanth	52	M	1041	1/10/2014	1/20/2014	1/27/2014	2				0	1	12			0		6
37	Ramesh	25	M	1829	1/19/2014	1/25/2014	2/2/2014	0				0	0	8			0		4
38	Shivamurthy	50	M	1917	1/20/2014	1/22/2014	1/30/2014	2				0	1	10			0		4.5
39	Habooli	62	M	1912	1/20/2014	1/22/2014	1/30/2014	2				0	1	10			0		5.5
40	Yankanna	40	M	2065	1/22/2014	1/24/2014	1/27/2014	0				0	1	7			0		5
41	Paratappa	65	M	2132	1/22/2014	1/31/2014	2/4/2014	2				0	1	12			0		5.5
42	Dayanand	55	M	3638	2/6/2014	2/8/2014	2/15/2014	0				0	1	8			0		5
43	Shivappa	60	M	3748	2/7/2014	2/10/2014	2/17/2014	0				0	0	8			0		4
44	Chandram	70	M	5627	2/26/2014	3/1/2014	3/4/2014	3				1	1	10			0		5
45	Chandrashekhar	62	M	6993	3/11/2014	3/15/2014	3/21/2014	1				0	0	8			0		4
46	Limbaji	70	M	7305	3/14/2014	3/18/2014	3/25/2014	1				0	0	8			0		4.5
47	Shrikanth	49	M	7846	3/20/2014	3/22/2014	3/28/2014	2				1	0	8			0		4
48	Ningappa	75	M	11410	4/1/2014	4/2/2014	4/7/2014	1				0	0	8			0		4.5
49	Suresh	40	M	11592	4/2/2014	4/4/2014	4/7/2014	0				0	0	8			0		4
50	Basavantray	75	M	12410	4/2/2014	4/4/2014	4/8/2014	1				0	0	8			0		4

Master Chart Group - II (STANDARD POLYPROPYLENE MESH)

								FOLLOW-UP AFTER 1 MONTH				FOLLOW-UP AFTER 3 MONTHS				FOLLOW-UP AFTER 6 MONTHS			
Sl. No	NAME	AGE IN YEARS	SEX	IP NO	DOA	DOS	DOD	PAIN (VAS SCORE 0-10)	SEROMA (Y-1, N-0)	HEMATOMA (Y-1, N-0)	INFECTION (Y-1, N-0)	CHRONIC PAIN (VAS SCORE 0-10)	FOREIGN BODY SENSATION (Y-1, N-0)	TIME TAKEN TO RETURN BACK TO NORMAL ACTIVITY (DAYS)	LIGHT PHYSICAL WORK{REPEATING DAILY WEIGHT OF <10KG} (MONTHS)	CHRONIC PAIN (VAS SCORE 0-10)	FOREIGN BODY SENSATION (Y-1, N-0)	TIME TAKEN TO RETURN BACK TO NORMAL ACTIVITY (DAYS)	A.LIGHT PHYSICAL WORK {REPEATING DAILY LIFTING OF LESS THAN 10KG} (MONTHS)
1	Shivappa	35	M	22775	10/8/2012	10/11/2012	10/19/2012	3				2	1	15		1	1		6
2	Channamallaya	58	M	23739	19-10--2012	10/20/2012	10/29/2012	3			1	2	1	15		1	1		6
3	Siddaram	47	M	25462	11/8/2012	11/9/2012	11/17/2012	0				0	0	8		0	0		4
4	Shankrappa	80	M	29749	12/18/2012	12/20/2012	12/27/2012	4	1			3	1	15		1	1		6
5	Siddu	40	M	2004	1/22/2013	1/24/2013	2/1/2013	2		1		1	1	15		0	0		6
6	Kallappa	27	M	4342	2/15/2013	2/18/2013	2/22/2013	2				1	1	8		0	0		4
7	Shivashankarappa	75	M	7196	3/14/2013	3/19/2013	3/26/2013	4			1	3	1	15		1	1		8
8	Siddaramappa	65	M	7404	3/16/2013	3/19/2013	3/26/2013	3				2	1	15		1	0		8
9	Mallappa	50	M	11823	4/29/2013	5/1/2013	5/9/2013	2				1	1	12		0	0		7
10	Md.Yasin Mulla	42	M	13449	5/17/2013	5/18/2013	5/21/2013	2				1	1	12		1	0		7
11	Noorkhan Dafedar	64	M	13613	5/18/2013	5/21/2013	5/24/2013	4				2	1	15		1	0		8
12	Chintappa	48	M	13677	5/20/2013	5/23/2013	5/28/2013	2		1		1	1	11		0	1		7
13	Sidram	40	M	14038	5/23/2013	5/25/2013	6/1/2013	3	1			2	1	10		1	1		6.5
14	Shreeshail	50	M	16692	6/18/2013	6/20/2013	7/1/2013	2				1	1	12		0	0		6
15	Sangappa	55	M	17070	6/22/2013	6/24/2013	6/27/2013	2				1	1	15		0	0		6
16	Vithobha	40	M	17885	6/29/2013	7/2/2013	7/5/2013	3				2	1	15		1	1		6
17	Madappa	80	M	19812	7/18/2013	7/27/2013	7/29/2013	3				3	1	15		0	0		5
18	Shridhar	26	M	20081	7/22/2013	7/24/2013	7/28/2013	4			1	2	1	15		1	1		6
19	Sanjeev	25	M	20267	7/23/2013	7/23/2013	7/29/2013	3				2	1	15		1	1		6
20	Annasab	28	M	21205	8/1/2013	8/2/2013	8/6/2013	3				2	1	15		1	0		6
21	Suresh	23	M	22235	8/12/2013	8/14/2013	8/17/2013	2				1	1	15		0	0		6
22	Hanamantappa	55	M	22481	8/14/2013	8/16/2013	8/22/2013	3			1	2	1	15		1	1		6
23	Shrishail	15	M	22678	8/16/2013	8/19/2013	8/23/2013	1				0	0	8		0	0		3.5
24	Siddappa	65	M	23141	8/21/2013	8/23/2013	8/27/2013	3		1		2	1	10		1	1		6
25	Gurappa	79	M	24733	9/5/2013	9/7/2013	9/18/2013	3	1			2	1	15		1	1		6
26	Mahadevappa	53	M	25166	9/9/2013	9/11/2013	9/19/2013	3				2	1	12		1	0		6
27	Madiwalappa	50	M	25670	9/14/2013	9/24/2013	10/1/2013	3				2	0	8		1	0		4.5
28	Rajashekhar	68	M	26925	9/26/2013	9/27/2013	10/4/2013	2				1	1	12					5
29	Habib	35	M	27737	10/5/2013	10/10/2013	10/15/2013	2			1	1	1	15		0	0		7
30	Sachin	18	M	29812	10/26/2013	10/29/2013	11/1/2013	3				2	1	15		1	1		7
31	Rajanna	63	M	30490	11/5/2013	11/7/2013	11/11/2013	3				1	1	15		0	0		6
32	Subhash	42	M	1162	11/8/2013	11/9/2013	11/17/2013	3				2	1	15		1	1		6
33	Mallikarjun	45	M	2644	11/25/2013	11/28/2013	12/5/2013	3				2	1	15		0	0		6
34	Suresh	34	M	3364	12/8/2013	12/12/2013	12/20/2013	2				1	0	15		0	0		5
35	Kalisab	56	M	313	1/3/2014	1/6/2014	1/14/2014	3	1			1	1	15		0	1		6
36	Somasing	60	M	866	1/9/2014	1/23/2014	1/27/2014	3				2	0	15		0	0		6
37	Umesh	35	M	2030	1/21/2014	1/21/2014	1/25/2014	2				1	1	15		0	0		6
38	Bhagwan	65	M	2018	1/21/2014	1/23/2014	1/27/2014	3	1			2	1	15		1	1		6
39	Chandappa	70	M	2576	1/27/2014	1/29/2014	2/5/2014	4			1	3	1	15		1	1		6.5
40	Kallappa	70	M	3127	2/1/2014	2/4/2014	2/14/2014	4	1			3	1	15		1	1		5
41	Goudappa	28	M	3567	2/6/2014	2/7/2014	2/14/2014	1				0	0	10		0	0		5
42	Gonu Sakaram	67	M	4099	2/11/2014	2/13/2014	2/17/2014	2				1	1	15		0	0		5
43	Imadappa	40	M	4763	2/18/2014	2/19/2014	2/27/2014	2				0	1	15		0	0		5
44	Ayyanagouda	45	M	4778	2/18/2014	2/20/2014	2/22/2014	2				0	1	12		0	0		5
45	Hanamantappa	63	M	5562	2/26/2014	3/4/2014	3/10/2014	2				1	0	15		0	0		6
46	Saipunsab	34	M	7726	3/19/2014	3/21/2014	3/25/2014	2				1	1	15		0	0		6
47	Ramappa	30	M	8293	3/24/2014	3/26/2014	4/3/2014	2				0	1	12		0	0		6
48	Desu Umalu	63	M	8432	3/25/2014	4/7/2014	4/16/2014	2				0	1	15		0	0		6