PREVALENCE OF INGUINODYNIA IN PATIENTS UNDERGOING HERNIOPLASTY IN A TERTIARY CARE HOSPITAL, COIMBATORE:A CROSS-SECTIONAL STUDY

Dissertation submitted to

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

In partial fulfilment of the degree of

M.S., GENERAL SURGERY

Branch – 1

PSG INSTITUTE OF MEDICAL SCIENCES AND RESEARCH

DEPARTMENT OF GENERAL SURGERY

MAY 2020

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled **"PREVALENCE OF INGUINODYNIA IN PATIENTS UNDERGOING HERNIOPLASTY IN A TERTIARY CARE HOSPITAL, COIMBATORE:A CROSS-SECTIONAL STUDY"** is a bonafide work done by **Dr. VINOTH. D** in partial fulfilment of the requirement for the degree of M.S. in General Surgery under my guidance.

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I hereby declare that this dissertation entitled "**PREVALENCE OF INGUINODYNIA IN PATIENTS UNDERGOING HERNIOPLASTY IN A TERTIARY CARE HOSPITAL, COIMBATORE:A CROSS-SECTIONAL STUDY**" is a bonafide and genuine research work carried out by me under the guidance of Dr. S. RAJESH KUMAR, M.S., Professor, Department of General Surgery, PSG Institute of Medical Sciences, Coimbatore.

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Place: Coimbatore

Signature of the Candidate

Dr. Vinoth. D

ACKNOWLEDGEMENT

First and foremost, I wish to thank my guide Dr. S. RAJESH KUMAR for helping and guiding me through each and every step of the process and his immense help in bringing it all together. I thank you sir for all the patience you have had with me.

I am ever so grateful to the HOD and the entire faculty of the Department of Surgery for the kind guidance, valuable advice, supervision and encouragement while doing this study.

I would like to thank my Principal for allowing me to conduct the study in our hospital and all the faculty in the Office of Research who have always been there to help me regarding any doubts or obstacles that I faced while conducting the study.

My thanks are also to my colleagues for the considerable help extended to me.

I wish to place on record my gratitude to all the patients who have been an integral part of this study. I am indebted to them for their willing participation.

PLAGIARISM CERTIFICATE

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ABSTRACT

INTRODUCTION

Repair of inguinal hernia, one of the most common surgical procedures performed, has over 20 million performed worldwide. Inguinodynia, which is a chronic pain following repair of inguinal hernia is significant, problem. It is under-reported. Randomized trials of laparoscopic vs open inguinal hernia repair have demonstrated similar recurrence rates with the use of mesh and have identified that chronic groin pain (>10%) surpasses recurrence (<2%) and is an important measure of success.

Chronic groin pain is potentially disabling with neuralgia, paraesthesia, hypoesthesia, and hyperesthesia. Patients may be unable to work, have limited physical & social activities, sleep disturbances, and psychological distress. Chronic postoperative inguinal pain (postherniorrhaphy inguinodynia or CPIP) is defined by the International Association for the Study of Pain as "pain beyond three months after inguinal hernia surgery". Inguinodynia is generally classified as neuropathic pain and non-neuropathic which is an inflammatory or nociceptive pain. Neuropathic pain usually is a result of nerve entrapment either by the inserted mesh or direct damage to inguinal nerves during surgery, On the other hand, non-neuropathic chronic postherniorrhaphy pain may follow a mesh or suture induced

inflammatory reaction of the inguinal region. Neuropathic inguinodynia ultimately can lead to a disabling disease.

Recurrence is insufficient to make patients' lives miserable, with mesh repair reporting up to a 21% incidence of inguinodynia. This led to a proposal that mesh repairs be abandoned and the transversalis or Shouldice Hospital repair be adopted. Incidence in one study shows upto 62.9%. Reduction of inguinodynia thus is the clinical outcome that has the greatest impact on patient satisfaction, health care utilization, societal cost, and quality of life.

AIMS AND OBJECTIVES:

The aim of this study was to know the burden of inguinodynia in patients undergoing hernioplasty for inguinal hernias

1. Primary objective: To estimate the 7prevalence of inguinodynia in patients undergoing hernioplasty in a tertiary health care centre in South India.
2. Secondary objective: To estimate the difference in prevalence of inguinodynia among open hernioplasty and laparoscopic hernioplasty (TEP and TAPP)

METHODOLOGY:

After obtaining institutional ethics committee approval, we have conducted a cross sectional study with 180 subjects recruited for the same. Calculating with a significance of $p< 0.05\%$, we have calculated that the number of subjects in each arm was 49, 31, and 102 respectively. Analysis was done comparing the incidence of inguinodynia among the subjects. The prevalence was tabulated and analysed.

Our secondary outcome was to determine the difference in prevalence among the various types of hernioplasties as differentiated in each group

RESULTS:

Data was compiled and analysed using Chi square test. It was noted that incidence of inguinodynia among the groups were 8.5, 12.9 and 9.8 % respectively. Overall, there was no statistically significant difference (p value 0.814, 0.821, 0.885) among the groups

CONCLUSION

As per this cross sectional study, the prevalence of inguinodynia Is 10%. There is no statistically significant difference in the overall technique of hernioplasty employed.

INTRODUCTION

Repair of inguinal hernia, one of the most common surgical procedures performed, has over 20 million performed worldwide. Inguinodynia, which is a chronic pain following repair of inguinal hernia is significant, problem. It is under-reported. Randomized trials of laparoscopic vs open inguinal hernia repair have demonstrated similar recurrence rates with the use of mesh and have identified that chronic groin pain (>10%) surpasses recurrence (<2%) and is an important measure of success.

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inflammatory reaction of the inguinal region. Neuropathic inguinodynia ultimately can lead to a disabling disease.

Treatment options include non surgical methods like analgesics, and surgical methods like laparoscopic retroperitoneal triple neurectomy, the results so far not satisfactory. The management of inguinodynia is a difficult problem for many surgeons and 5–7% of patients experiencing post-hernia repair groin pain litigate. Patients are now concerned more about inguinodynia than recurrence as the predominant factor affecting quality of life. Recurrence is insufficient to make patients' lives miserable, with mesh repair reporting up to a 21% incidence of inguinodynia. This led to a proposal that mesh repairs be abandoned and the transversalis or Shouldice Hospital repair be adopted. Incidence in one study shows upto 62.9%. Reduction of inguinodynia thus is the clinical outcome that has the greatest impact on patient satisfaction, health care utilization, societal cost, and quality of life.

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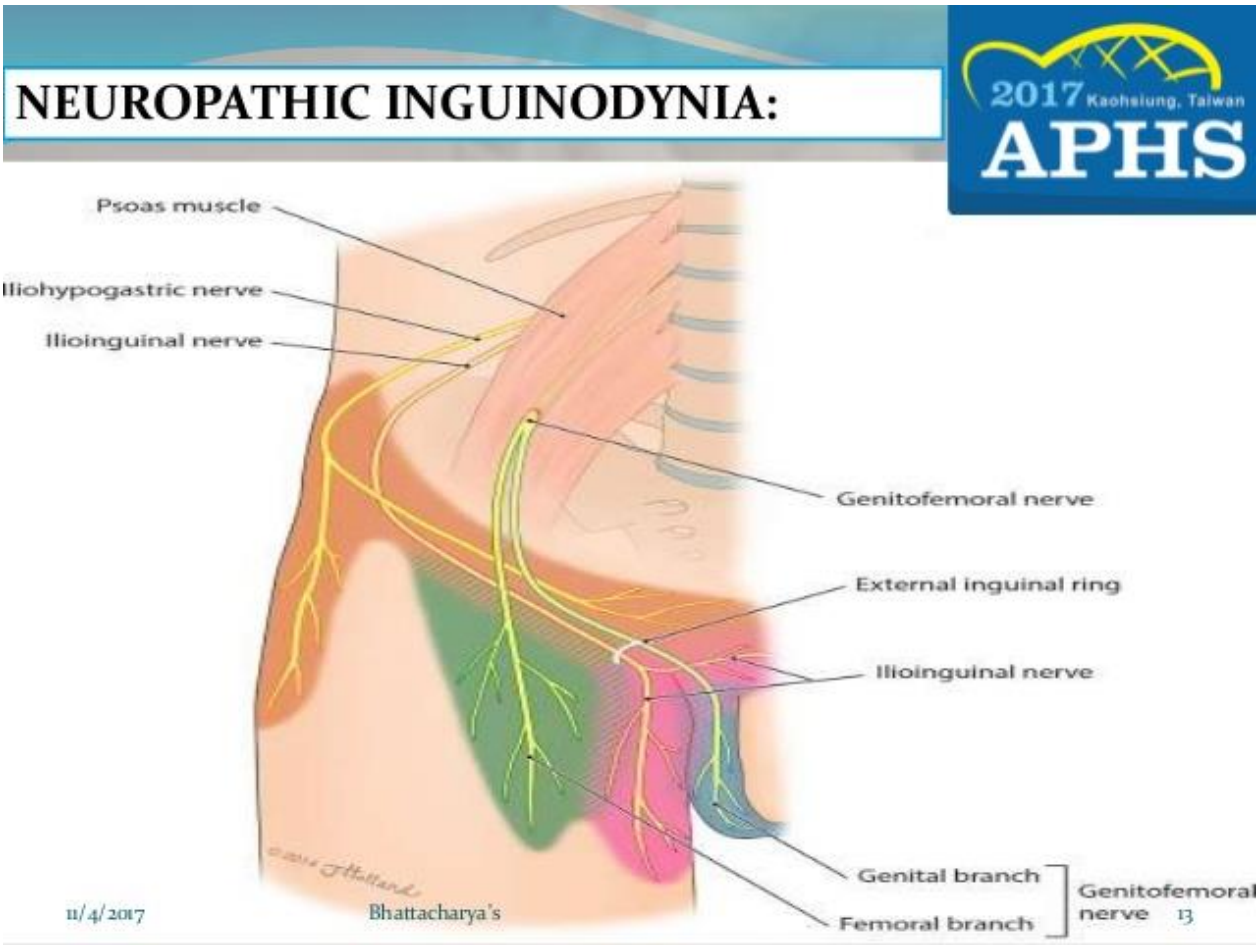
REVIEW OF LITERATURE

Hernia was present in the human history from its very beginning. The role of surgery was then restricted only to the treatment of huge umbilical and groin hernias and life-threatening incarcerated hernias. The evolution of treatment of groin hernia can be divided into five eras namely introduction of antiseptic and aseptic procedures, high ligation of hernia sac, narrowing of the internal inguinal ring, reconstruction of the posterior wall of inguinal canal, and in view of high recurrence rates, mesh repair i.e. the fifth rule of groin hernia repair namely "tensionless repair". Though mesh reduced the recurrence rates, another significant problem namely inguinodynia was cropping up.



Importance of groin anatomy

Knowledge of anatomy is paramount in preventing injury to the groin nerves which leads to inguinodynia. The most commonly affected nerves are iliohypogastric, ilioinguinal, and genital branch of the GFN. The course of the nerves are explained in detail as enumerated below.

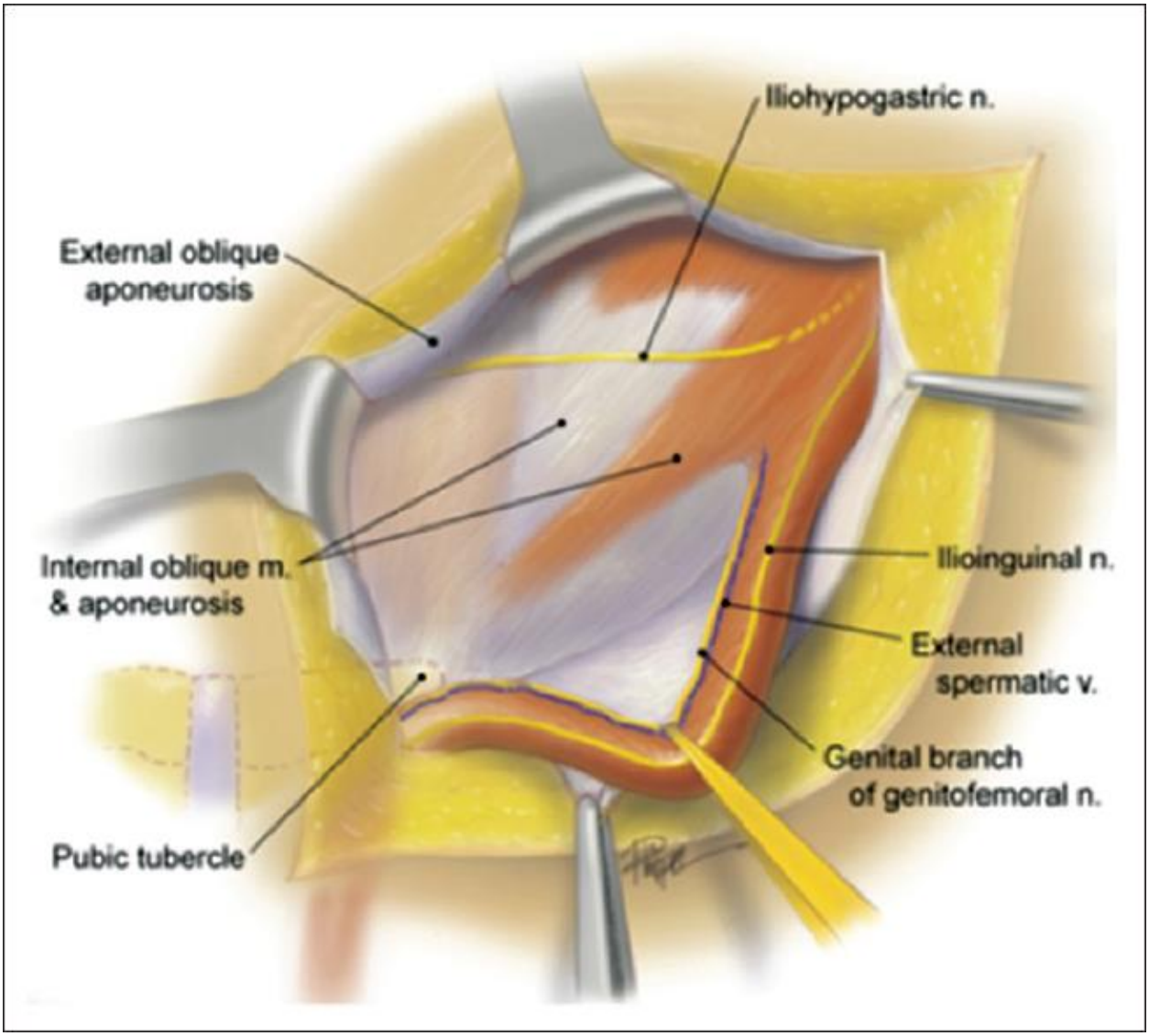


Figure 1: Neuroanatomy of the anterior inguinal canal

The lumbar plexus

The lumbosacral plexus provides the nerve supply for the pelvis and lower extremities as well as the autonomic visceral innervation to the pelvic organs. This is subdivided into four parts: lumbar, sacral, pudendal, and coccygeal plexuses.

The lumbar plexus which innervates the lower abdomen, inguinal region, and upper thigh is formed by the union of the anterior primary divisions of the lumbar nerves with overlap from the adjacent nerve roots and plexuses. Typically, the anterior rami of the first three lumbar nerves coalesce to form the plexus along with part of the fourth lumbar nerve and frequently a communicating branch from the subcostal (T12) nerve. This variability and cross-innervation leads to overlapping areas of nerve distribution rather than a typical segmental innervation.[14] The lumbar plexus is located in the posterior abdominal wall in front of the transverse processes of the lumbar vertebrae and posterior to or within the psoas muscle.

All branches of the lumbar plexus may be affected by inguinal hernia repairs, but the Iliohypogastric nerve, Ilioinguinal nerve and genitofemoral nerve are at most risk within the inguinal canal due to direct exposure with anterior repairs. The Lateral femorocutaneous nerve and genitofemoral trunk traverse the preperitoneal plane and are most at risk with posterior repairs. The obturator nerve and femoral nerve may infrequently be injured along their course in the preperitoneal plane. Any portion of an inguinal hernia repair that penetrates the posterior boundary of the inguinal canal either from above or below can injure the nerves within the adjacent compartment. The inguinal nerves can be injured with posterior repairs using penetrating fixation, while the genitofemoral trunk and

femoral nerve can be injured or entrapped with anterior fixation that penetrates too deeply. Understanding the likely location and course of these nerves, as well as the potential sites, and mechanisms of injury of these nerves helps to prevent these technical injuries during hernia repair.[5],[12]

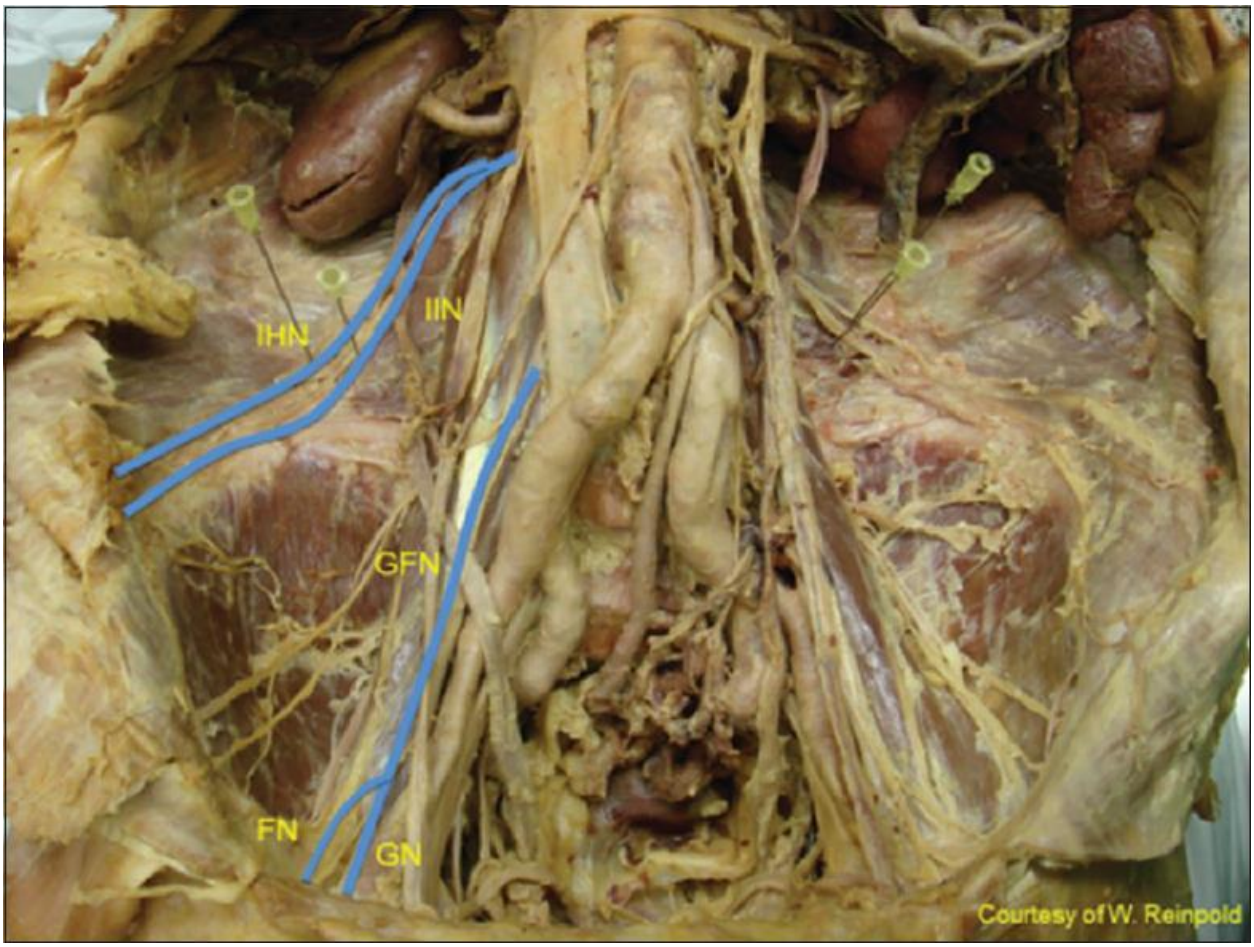


Figure 2: Inguinal retroperitoneal neuroanatomy: IHN = Iliohypogastric nerve, IIN = Ilioinguinal nerve, GFN = Genitofemoral nerve

Iliohypogastric nerve

The iliohypogastric nerve is a mixed sensorimotor nerve and originates from the ventral ramus of L1 emerging from the upper lateral border of the psoas major.[12],[14] It travels over the quadratus lumborum muscle behind the lower renal pole and then enters the posterior part of the transversus abdominus muscle above the iliac crest. Between the transversus and internal oblique muscles, the iliohypogastric nerve divides into a lateral and an anterior cutaneous branch. The lateral branch travels between the internal and external oblique muscles above the iliac crest and innervates the posterolateral gluteal skin. The anterior cutaneous branch runs between the transversus and internal oblique innervating both of these muscles. Approximately 2 cm medial to the anterior superior iliac spine (ASIS), the iliohypogastric nerve exits the internal oblique muscle and passes inferomedially within the inguinal canal before exiting through the external oblique. It exits approximately 3 cm above the superficial external ring at the conjoined tendon, within the cleavage plane between the internal and external oblique. This branch provides sensation to the medial suprapubic skin.

There is a significant variation in the iliohypogastric nerve course from its origin at the L1 nerve root to its terminus in the dermatomal distribution of the suprapubic skin [Figure 3]. This anatomic variability increases as the nerve travels distally..

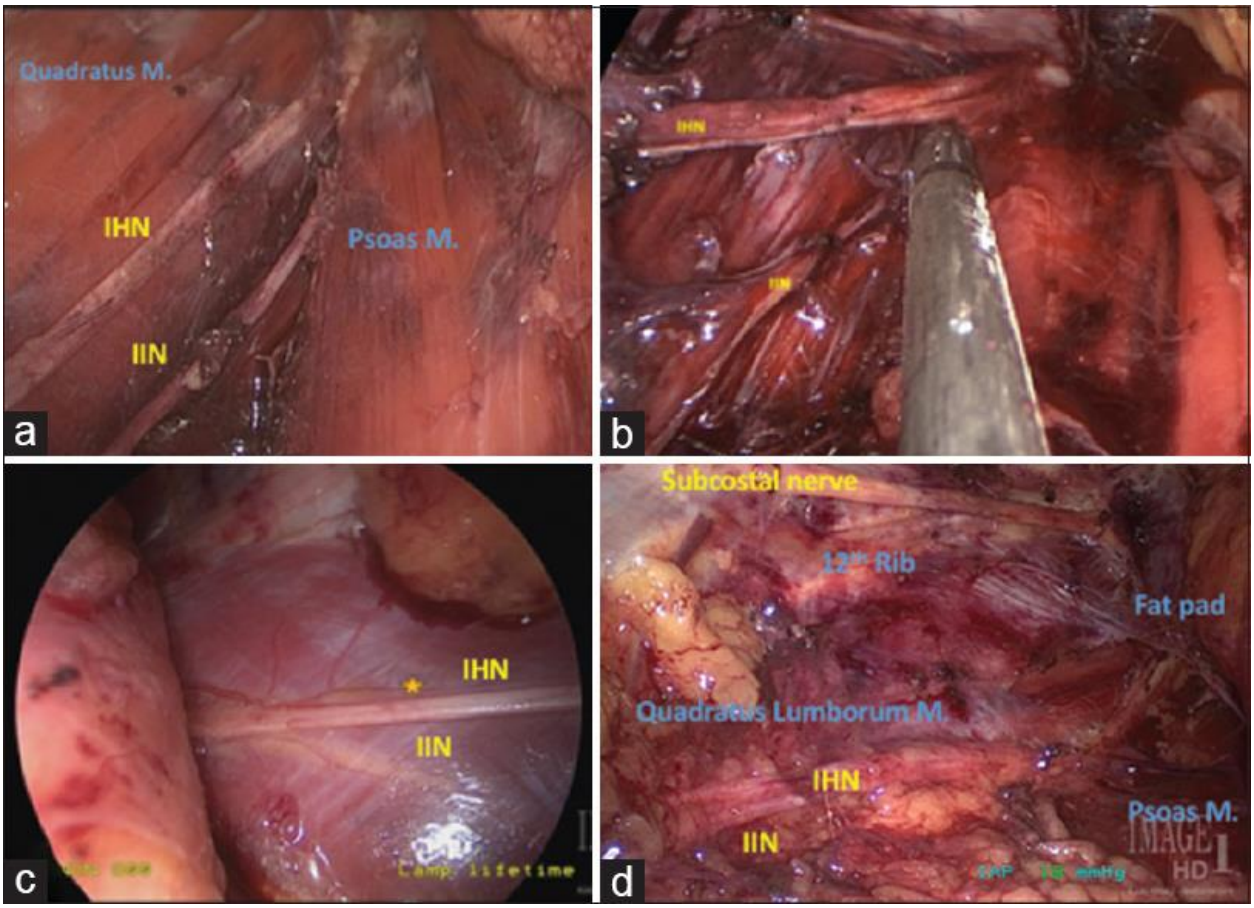


Figure 3: Anatomic variation of the upper lumbar plexus – iliohypogastric and ilioinguinal nerves: (a) Two separate trunks. (b) Two trunks bifurcate at L1. (c) Common trunk. (d) Adjacent but separate trunk

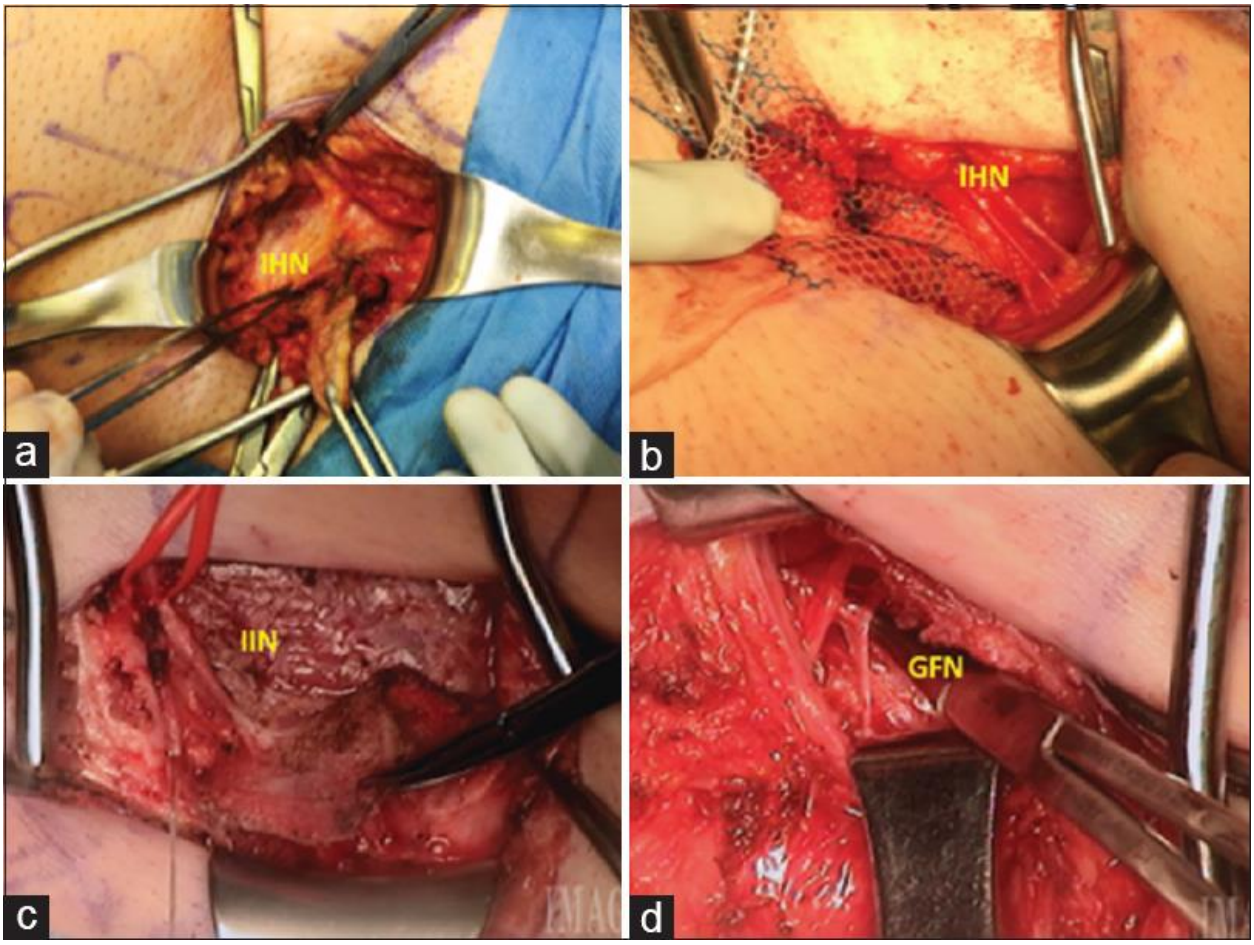


Figure 4: Anterior inguinal nerves. (a) Iliohypogastric nerve entrapped by anterior mesh. (b) IHN with duplicated branches passing to conjoined tendon (mesh folded medially). (c) Ilioinguinal nerve entrapped by mesh cephalad and lateral to internal ring near anterior superior iliac spine. (d) Genitofemoral nerve in preperitoneal space below split floor of inguinal canal (cephalad to internal ring)

Given the highly variable nature and course of the iliohypogastric nerve and its course, injury to the iliohypogastric nerve is common especially if the course of the nerve is not identified. The mechanism of injury to the iliohypogastric nerve in inguinal hernia repair is primarily within the inguinal canal [Figure 4].

The retroperitoneal course of the iliohypogastric nerve is cephalad and lateral outside the field of both open anterior and posterior minimally invasive approaches. The inguinal segment, however, may be injured with both anterior and posterior inguinal hernia repairs. In anterior tissue based (Bassini, McVay, Shouldice) repairs, the inguinal portion of the nerve may be injured by dissection, traction, thermal or electric injury, inflammatory scarring, or entrapment by suture [Figure 4]a. In anterior (Lichtenstein) and open posterior (transinguinal preperitoneal [TIPP] and variations) mesh-based repairs, injury from mesh fixation, entrapment from mesh folding or meshoma, or inflammation and scarring from mesh integration may occur in addition to these mechanisms of injury. In minimally invasive laparoscopic and robotic inguinal hernia repair, the iliohypogastric nerve is only at risk with penetrating fixation passing through the transversalis fascia, which can lead to injury, entrapment, or division of the nerve [Figure 5].

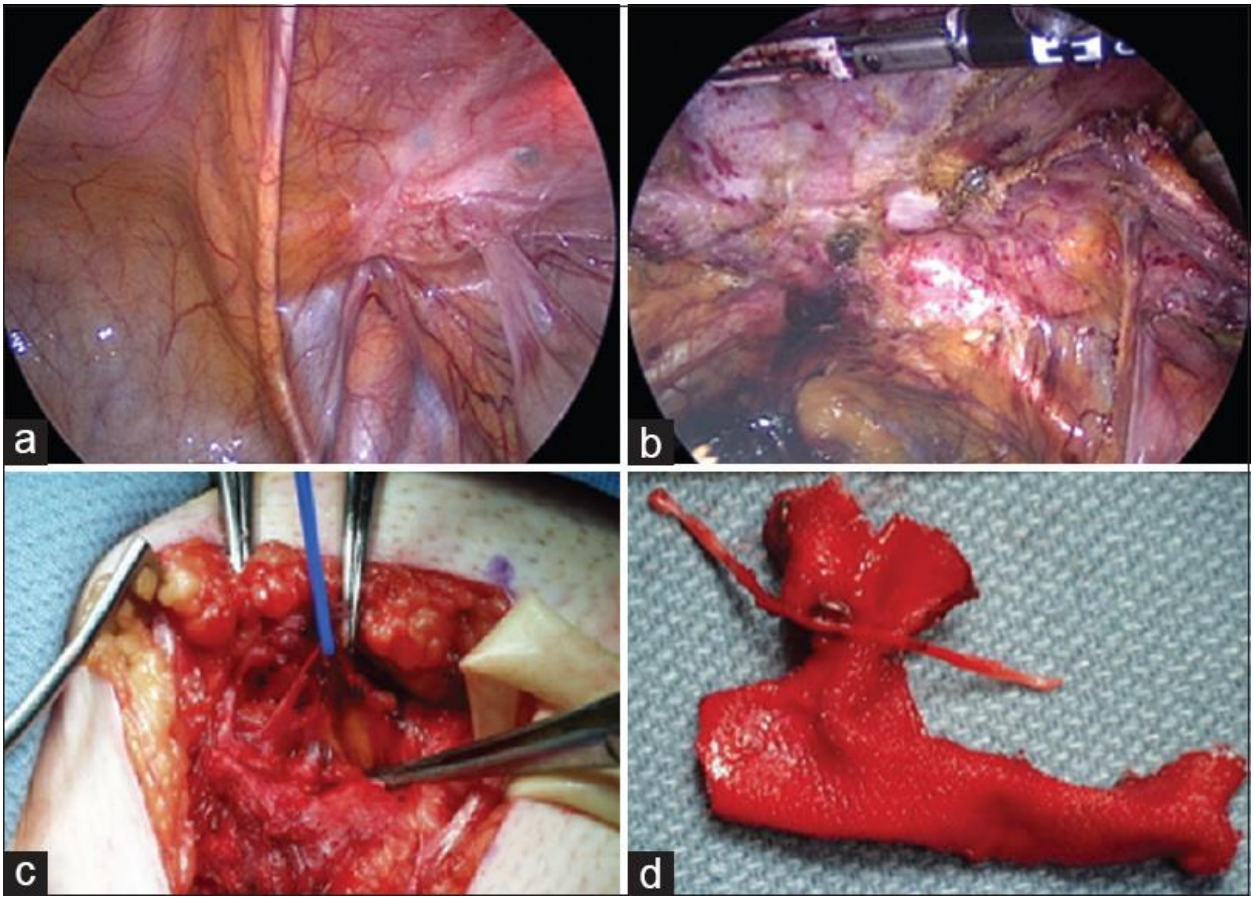


Figure 5: Injury to inguinal nerves from posterior mesh fixation: (a) Folded and tacked preperitoneal mesh. (b) Preperitoneal dissection with mesh and tacks. (c) Open dissection with tack penetrating ilioinguinal nerve through floor of inguinal canal. (d) Mesh and tack capturing ilioinguinal nerve

Ilioinguinal nerve

The ilioinguinal nerve is a mixed sensorimotor nerve arising from the first ventral lumbar ramus. It is typically smaller than the iliohypogastric nerve and emerges from the superolateral border of the psoas muscle with or inferior to the iliohypogastric nerve [Figure 3]. The ilioinguinal nerve then travels over the

quadratus muscle and upper part of the iliacus and enters the transversus abdominus muscle near the iliac crest. The ilioinguinal nerve at this point may reconnect with the iliohypogastric nerve. The nerve innervates the internal oblique muscle and then pierces it lower than the iliohypogastric approximately 1 cm medial to the anterior superior iliac spine [Figure 4]c. There is considerable variability of the ilioinguinal nerve in the inguinal canal, but the nerve will typically travel over the spermatic cord, exiting with the cord through the superficial external inguinal ring to supply the proximal medial skin of the thigh, inguinal crease, upper scrotum, and lateral base of the penis in males. In females, the ilioinguinal nerve innervates the skin covering the medial thigh, mons pubis, and labia majora.

Similar to the iliohypogastric nerve, there is a significant variation in the ilioinguinal nerve from its origin at the L1 nerve root to its terminus in the suprapubic skin. This anatomic variability increases as the nerve travels distally with multiple different potential pathways through or outside of the inguinal canal.

As with the iliohypogastric nerve, the highly variable nature of the ilioinguinal nerve increases the risk of injury, especially if the course of the nerve is not identified. During inguinal hernia repair, the ilioinguinal nerve is most

frequently injured within the inguinal canal. The retroperitoneal course of the ilioinguinal nerve is cephalad and lateral outside the field of both open anterior and minimally invasive posterior approaches. The inguinal segment of the ilioinguinal nerve, however, may be injured with both anterior and posterior inguinal hernia repairs. In anterior tissue based (Bassini, McVay, Shouldice) repairs, the inguinal nerve may be injured by dissection, traction, thermal or electric injury, inflammatory scarring, or entrapment by suture. In anterior (Lichtenstein) and open posterior (TIPP and variations) mesh-based repairs, injury from mesh fixation, entrapment from mesh folding or meshoma, or inflammation and scarring from mesh integration may occur along with these mechanisms of injury. Similar to the iliohypogastric nerve, in minimally invasive laparoscopic and robotic inguinal hernia repair, the ilioinguinal nerve is only at risk with penetrating fixation passing through the transversalis fascia injuring, entrapping, or dividing the nerve

[Figure 5].

Genitofemoral nerve

The genitofemoral nerve is a mixed sensorimotor nerve originating from the L1 and L2 ventral rami and forms within the psoas muscle [Figure 6]. It descends within the muscle and emerges on its medial border between the L3 and L4 level. It descends below the peritoneum overlying the psoas muscle, passes posterior to the ureter, and travels toward the inguinal ligament. The bifurcation into the genital and femoral branches ranges from separate genital and femoral trunks exiting the psoas muscle to a shared trunk continuing to the level of the inguinal ligament. The genital branch will typically pass over the external iliac artery and traverse the deep internal inguinal ring to join the cord structures or round ligament before entering the inguinal canal. In males, it provides motor innervation to the cremasters and sensation to the skin of the upper scrotum. In females, the genital nerve has a cutaneous branch that innervates the mons pubis and labia majora. The femoral branch descends lateral to the cord structures and iliac vessels passing underneath the inguinal ligament. It enters the femoral sheath lateral to the femoral artery and then pierces the femoral sheath and fascia lata to supply the skin of the upper anterior thigh over the femoral triangle. The variability of the genitofemoral nerve has been well documented in several anatomic studies, and the genitofemoral nerve is considered to be the most variable of the lumbar plexus nerves.

Injury to the genital branch or femoral branch of the genitofemoral nerve in the preperitoneal space may occur after open preperitoneal (TIPP, bilayer mesh, plug and patch, plug) [Figure 6]c and laparoscopic preperitoneal repair due to overdissection of the lateral triangle of pain, thermal/electric injury, traction, irritation or scarring from mesh, entrapment within meshoma, or damage from fixation sutures or tacks [Figure 6]d. In open anterior tissue (Bassini, Shouldice, McVay) or mesh (Lichtenstein) repair, the genital nerve may be inadvertently injured by stripping the cremaster, disrupting the spermatic cord, overdissecting the cord structures, contacting the nerve with mesh, strangling the cord with a tight mesh internal ring, or through mesh folding, contraction, or meshoma formation. In open anterior tissue or mesh repair, the femoral branch of the genitofemoral nerve is rarely at risk but may be injured with deep lateral suture fixation to the inguinal ligament used to suture the floor in tissue-based operations or the mesh to the inguinal ligament in anterior-based mesh repairs.

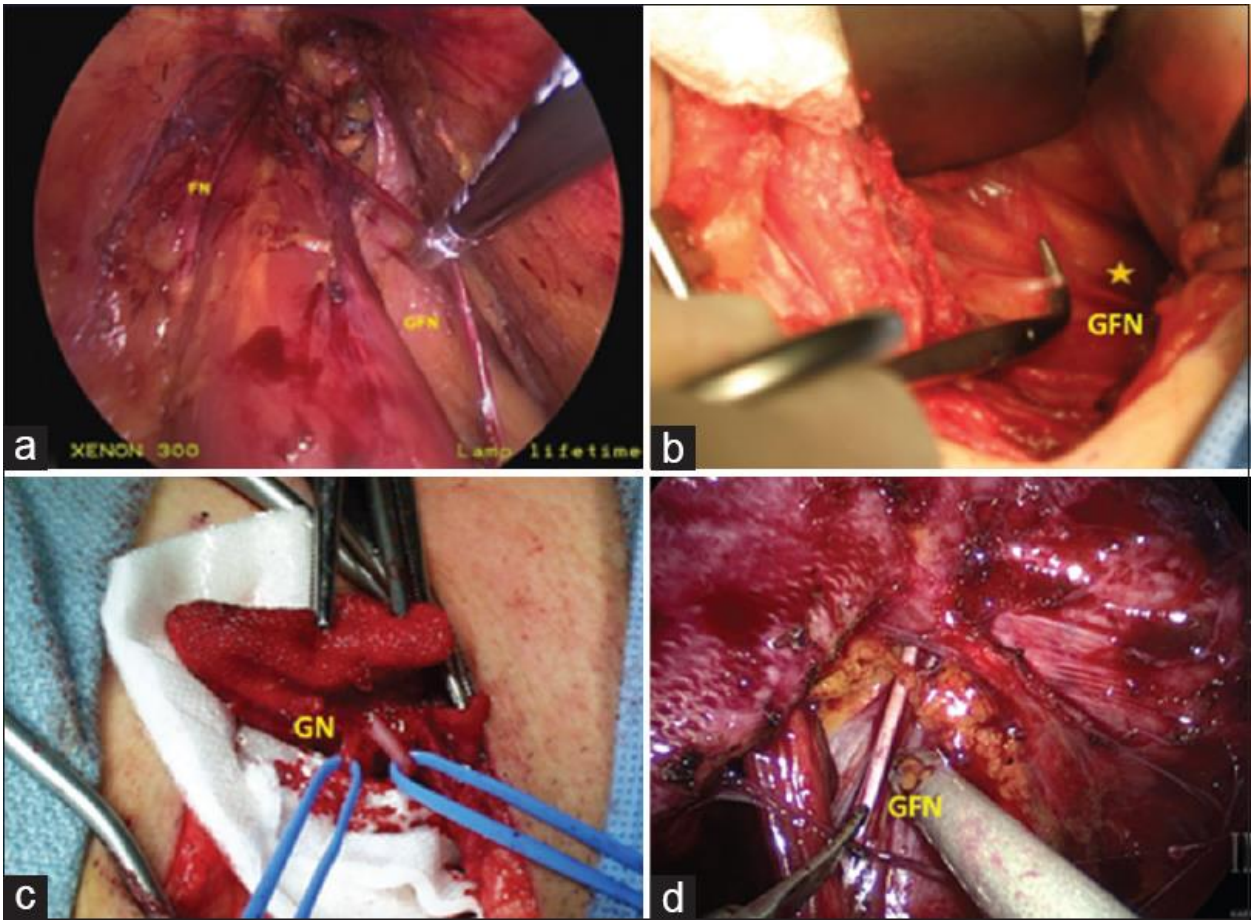


Figure 6: Genitofemoral nerve: (a) Laparoscopic view of genitofemoral nerve over psoas muscle. (b) Open extended approach to genitofemoral nerve over psoas muscle. (c) Genital branch trapped by mesh plug with vas deferens. (d) Genitofemoral nerve Trapped by lap mesh at internal ring

Lateral femoral cutaneous nerve

The lateral femoral cutaneous nerve is a purely sensory nerve with wide variability in its origin and course. It usually originates from the posterior division of second and third lumbar nerve roots but may also arise from a high L1/L2 or low L3/L4 origin. Another course is, it may also arise directly from the femoral nerve or as an

independent branch directly from the lumbar plexus. The nerve emerges from the lateral border of the psoas below the iliac crest and travels behind the peritoneum over the iliacus muscle obliquely toward the anterior superior iliac spine (ASIS). It supplies sensory fibers to the parietal peritoneum in the iliac fossa. The nerve then passes behind or through the inguinal ligament approximately 1 cm medial to the anterior superior iliac spine halfway between the anterior superior iliac spine and femoral artery. The lateral femoral cutaneous nerve then travels anterior to or through the sartorius muscle before dividing into anterior and posterior superficial branches. The anterior branch supplies the anterior and lateral thigh to the level of the knee and joins the peripatellar plexus. The posterior branch pierces the fascia lata higher than the anterior branch and divides to innervate the skin on the lateral thigh surface from the greater trochanter to the mid-thigh with occasional extension to the gluteal skin.

The lateral femoral cutaneous nerve nerve, which is a purely sensory nerve, is highly variable with absent, duplicated, or numerous branches and significant cross-innervation [Figure 7].

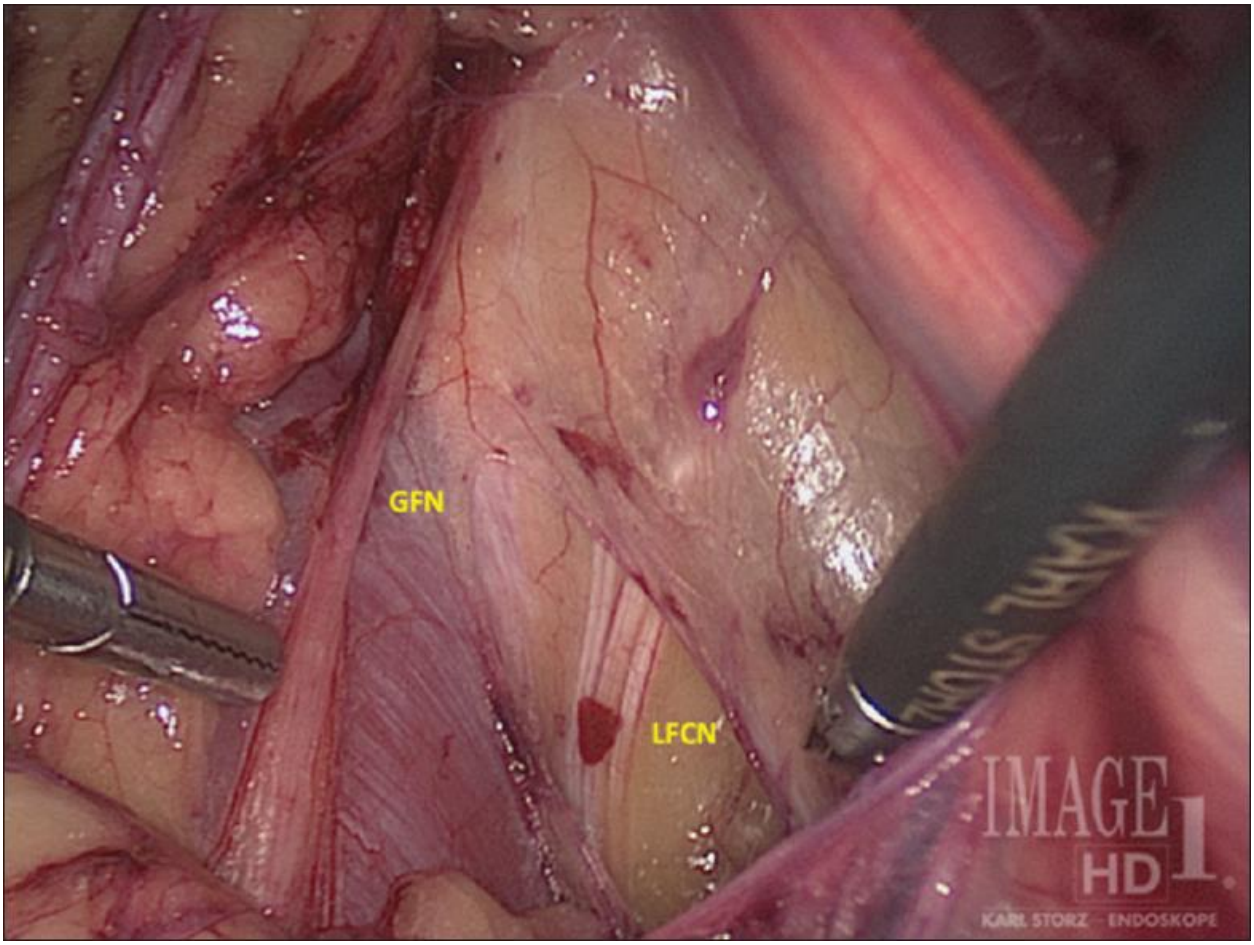


Figure 7: Lateral femoral cutaneous nerve (3 branches) passing lateral to psoas muscle over iliacus. Genitofemoral nerve trunk over psoas

Although there is considerable variability, lateral femoral cutaneous nerve injury is uncommon during inguinal hernia repair and the lateral femoral cutaneous nerve is typically only at risk during posterior inguinal hernia repair approaches. Overdissection of the lateral compartment, thermal or electrical injury, mesh irritation or inflammation or entrapment, and fixation below the iliopubic tract with suture or tacks may injure the lateral femoral cutaneous nerve as it crosses the iliacus lateral to the psoas [Figure 7]. In anterior inguinal repairs, the lateral

femoral cutaneous nerve is typically not at risk as it traverses cephalad and lateral to the operative field.

Femoral nerve

Femoral nerve, a mixed sensorimotor nerve which originates from L2 to L4 ventral rami, is located lateral to the psoas muscle. It travels in the cleavage plane between the psoas and iliacus muscles [Figure 8]. Piercing the iliacus muscle, it is covered by iliac fascia, which separates it from the iliac vessels. It gives off branches to supply the iliacus and pectineus muscle and then is positioned lateral to the femoral artery and vein as it continues below the inguinal ligament. The anterior division has two sensory branches that supplies the anteromedial thigh and two motor branches that supply the pectineus and sartorius muscles. The posterior division gives off a sensory branch, saphenous nerve, and motor branches to the quadriceps muscle with branches to the hip and knee joint.

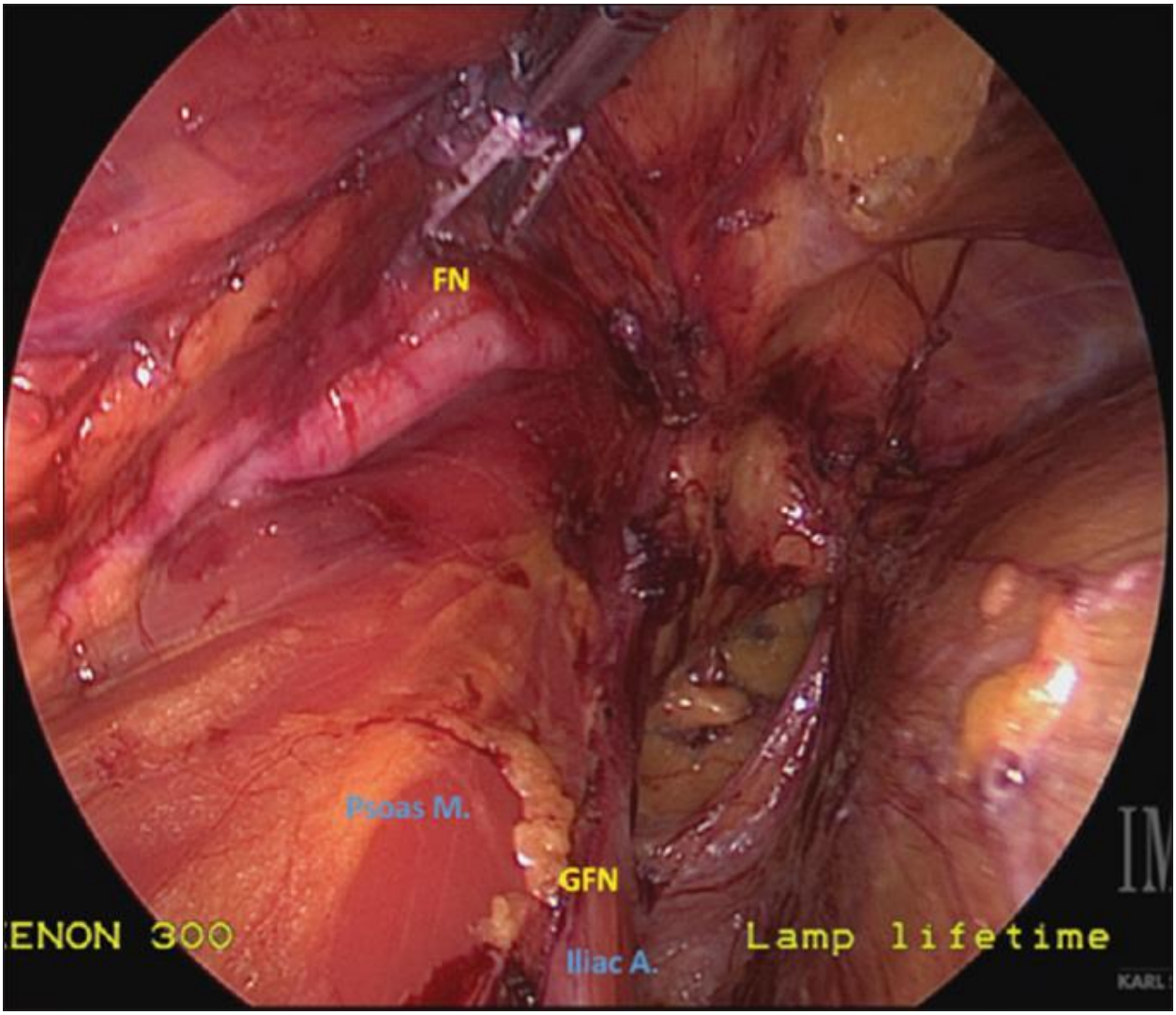


Figure 8: Femoral nerve passing lateral to psoas in groove between psoas and iliacus. Genitofemoral nerve on anterior surface of psoas muscle

Although infrequently seen as a complication of inguinal hernia repair, the femoral nerve may be injured with lateral dissection or fixation in the preperitoneal and retroperitoneal space during open or laparoscopic posterior inguinal hernia repairs, or it may be injured with deep penetrating fixation with sutures or tacks along the inguinal ligament lateral to the femoral vessels during open anterior repairs. Damage to the femoral nerve will result in atrophy of the anterior thigh

muscles with resultant weakness of the quadriceps muscle and difficulty walking uphill or climbing stairs. Accompanying sensory disturbances, such as pain or numbness in the anterior thigh distribution, may be found on dermatosensory mapping.

Obturator nerve

The obturator nerve is a sensorimotor nerve arising from the anterior division of the second to fourth lumbar ventral rami and supplies the medial compartment of the thigh. The obturator nerve descends through the psoas major and emerges from the medial border at the pelvic brim, crosses the sacroiliac joint posterior to the iliac vessels, and runs along the lateral pelvic wall medial to the obturator internus and anterosuperior to the obturator vessels. It then exits the obturator foramen to supply the upper thigh, providing motor innervation to the adductor and obturator muscles and sensation to the medial thigh. Variations of the obturator nerve include a high form originating from L1 to L4 and a low form from L2 to L5 as well as a highly variable cutaneous sensory distribution. Injury to the obturator nerve is extremely uncommon in inguinal hernia surgery. Open anterior preperitoneal repairs (TIPP, plug and patch, plug, bilayer mesh) may potentially injure the nerve with medial mesh placement or blind medial dissection. More likely, in minimally invasive posterior repairs, overdissection of the obturator

foramen, mesh folding or irritation, or malpositioned mesh fixation with tack or sutures may potentially, however infrequently, injure the obturator nerve. The resultant injury may clinically present as atrophy of the medial thigh, numbness or pain in the cutaneous distribution along the distal medial thigh, or weakness or paralysis of hip adduction.

Thus Chronic inguinodynia may develop after all methods of hernia repair and is independent of technique. The neuroanatomy of the inguinal canal is complex and highly variable from the retroperitoneal lumbar plexus to the terminal branches exiting through the inguinal canal. Neuropathic pain from nerve injury or entrapment is a common mechanism. While it is not possible to completely prevent injury due to the considerable neuroanatomic variability and inevitability of postoperative scarring, nerve injury is often technical and related to inadvertent iatrogenic damage. Multiple studies have demonstrated the feasibility of routine nerve identification, the benefit of focused neuroanatomic teaching, and the efficacy of nerve sparing in the reduction of inguinodynia. An in-depth understanding of groin neuroanatomy and potential causes of pain unique to each operative technique allows for a “nerve-mindfulness” approach that increases nerve identification and preservation, decreases injury, and improves patients outcomes.

The nerves most commonly affected in CPIP are the iliohypogastric, ilioinguinal, and genital branch of the GFN. In open anterior tissue and mesh repairs, techniques such as three-nerve identification, local anesthesia infiltration, preservation of the investing fascia around the inguinal nerves, meticulous avoidance of nerve injury during suture repair of the canal or fixation of the mesh, lightweight mesh usage, and pragmatic neurectomy of nerves deemed to be injured or at risk during the primary operation all help to decrease the risk of CPIP. In laparoscopic and minimally invasive repair, techniques such as preserving the transversalis fascia to prevent overdissection of the inguinal nerves, judicious use or avoidance of penetrating mesh fixation, avoidance of posterior suturing of the myopectineal orifice, and careful deployment and positioning of mesh prostheses all help to prevent technical complications that may lead to nerve injury. Although infrequent, the lateral femorocutaneous nerve, femoral branch of the genitofemoral nerve, femoral nerve, and obturator nerve may also be injured in the preperitoneal space and similar avoidance of overdissection, limited or no penetrating fixation, and meticulous mesh placement will help to limit the risk of these infrequent injuries.

The evolution of the 5 principles of hernioplasty

The evolution of treatment of groin hernia can be divided into five eras. The oldest epoch was ancient era from ancient Egypt in the15th century where the description of a hernia was formed. Most essential knowledge concerning hernias in ancient times derives from Galen. Herniology flourished mainly due to many anatomical discoveries. In the 19th to middle 20th century, Introduction of anesthesia and antiseptic procedures constituted the beginning of modern hernia surgery known as era of hernia repair under tension. Three substantial rules were initially introduced to hernia repair technique namely antiseptic and aseptic procedures. high ligation of hernia sac and narrowing of the internal inguinal ring. However, in spite of the progress the treatment results were poor. Recurrence rate during four years was 100% and postoperative mortality gained even 7%. This led to a new surgical technique described by Bassini where the next rule of hernia repair ie. reconstruction of the posterior wall of inguinal canal was formed. E. Shouldice then proposed imbrication of the transverse fascia and strengthening of the posterior wall of inguinal canal by four layers of fasciae and aponeuroses of oblique muscles. These modifications decreased recurrence rate to 3%.

The next epoch in the history of hernia surgery lasting to present days is referred to as era of tensionless hernia repair. The tension of sutured layers was reduced by incisions of the rectal abdominal muscle sheath or using of foreign materials. The turning point in hernia surgery was discovery of synthetic polymers by Carothers in 1935. The first tensionless technique described by Lichtenstein was based on strengthening of the posterior wall of inguinal canal with prosthetic material. Lichtenstein published the data on 1,000 operations with Marlex mesh without any recurrence in 5 years after surgery. Thus fifth rule of groin hernia repair "tensionless repair" was introduced.

Another treatment method was popularized by Rene Stoppa, who used Dacron mesh situated in preperitoneal space without fixing sutures. First such operation was performed in 1975, and reported recurrence rates were quite low (1.4%). The next type of repair procedure was sticking of a synthetic plug into inguinal canal. Lichtenstein in 1968 used Marlex mesh plug (in shape of a cigarette) in the treatment of inguinal and femoral hernias. The mesh was fixated with single sutures. The next step was introduction of a Prolene Hernia System which enabled repair of the tissue defect in three spaces: preperitoneal, above transverse fascia and inside inguinal canal. Laproscopic treatment of groin hernias began in 20th century. The first laparoscopic procedure was performed by P.

Fletcher in 1979. In 1990 Schultz plugged inguinal canal with polypropylene mesh. In 1992, TAPP was introduced by Arregui et al. and Dion and Morin. Dulucq (1991), McKernan and Laws (1992), and Phillips et al. (1993) recommended a totally extraperitoneal (TEP) approach to avoid intraperitoneal complications. Femoral and bilateral defects were taken care of in a similar fashion.

The disadvantages of laparoscopic approach were: high cost and risk connected with general anesthesia. However, These techniques incur fewer recurrences than open techniques and diminish postoperative pain. The discovery of the preperitoneal space of Bogros, which, in the 1870s, was employed for the anterior repair of groin herniation. The posterior preperitoneal approach became established in the 1920s–1960s, along with the use of prostheses. Anterior preperitoneal repair of inguinal and femoral herniation was introduced when Annandale (1876), His procedure was employed by Ruggi (1892), who sutured the inguinal ligament down to Cooper's ligament. Lotheissen (1898) brought the conjoint tendon down instead. Moschowitz (1907) added an anterior herniorrhaphy to prevent recurrence.

Thus, the history of groin hernia repair evolved from life-saving procedures in case of incarcerated hernias to elective operations performed within the limits of 1 day surgery

Fig.9: Pioneers in hernioplasty

Pathophysiology of Chronic pain:

Pain was called by Sherrington, "the physical adjunct of an imperative protective reflex." when tissue is damaged, central nociceptive pathways are sensitized and reorganized which leads to persistent or chronic pain. The International Association for the Study of Pain defined pain as, "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage." Chronic pain includes inflammatory pain and neuropathic pain. It persists long after recovery from an injury and is often refractory to common analgesic agents, including nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids .

Chronic pain can result from nerve injury (neuropathic pain) including diabetic neuropathy, toxin-induced nerve damage, and ischemia. Causalgia is a type of neuropathic pain. Pain is often accompanied by hyperalgesia and allodynia. Hyperalgesia is an exaggerated response to a noxious stimulus, and allodynia is a sensation of pain in response to a normally innocuous stimulus. An example of the latter is the painful sensation from a warm shower when the skin is damaged by sunburn. Hyperalgesia and allodynia signify increased sensitivity of nociceptive afferent fibers. Figure 1 shows how chemicals released at the site of injury can further directly activate receptors on sensory nerve endings

leading to inflammatory pain. Injured cells also release chemicals such as K + that directly depolarize nerve terminals, making nociceptors more responsive (sensitization).

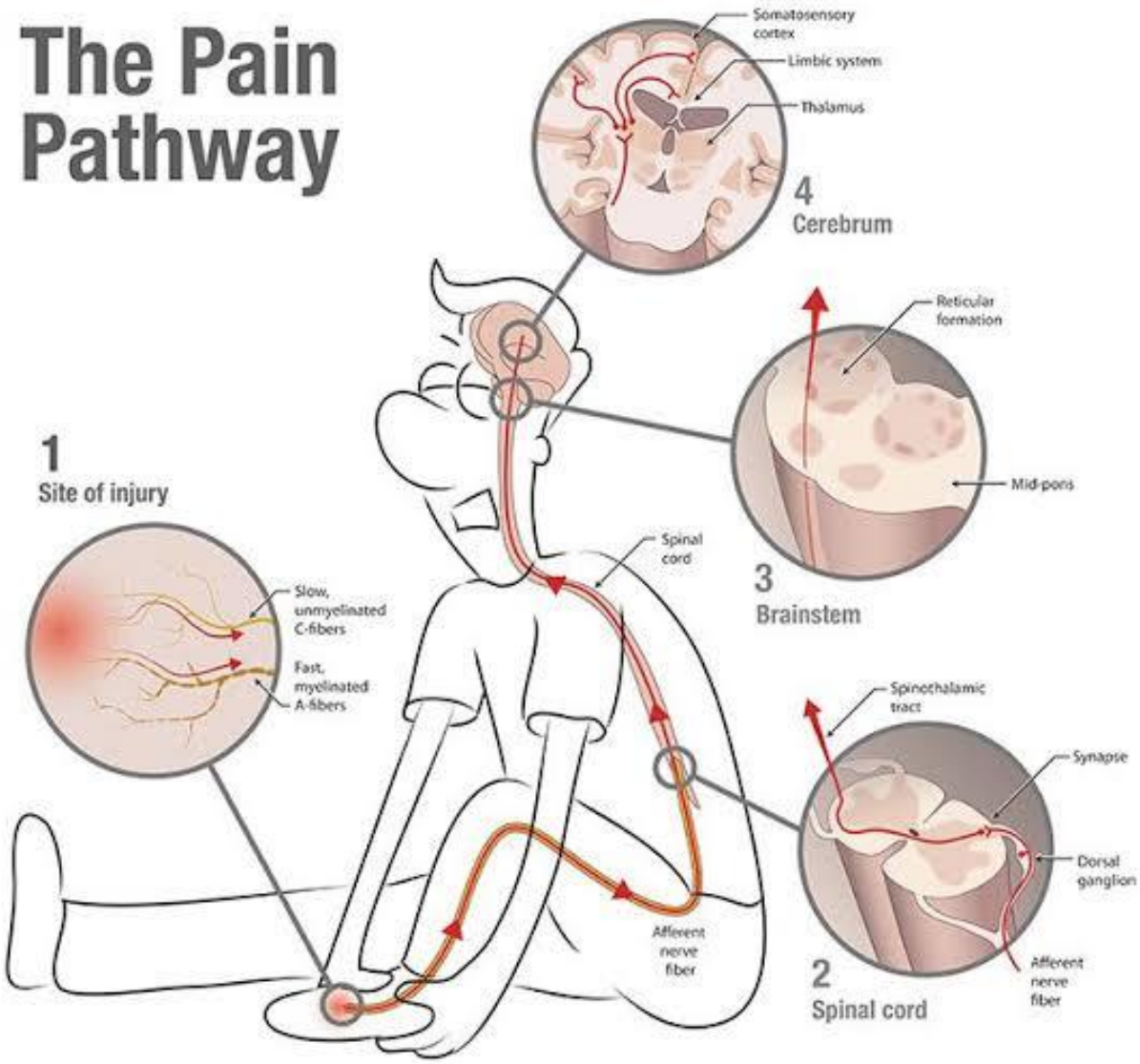


Fig.10: The pain pathway

Injured cells also release bradykinin and substance P, which can further sensitize nociceptive terminals. Histamine is released from mast cells, serotonin (5-HT) from platelets, and prostaglandins from cell membranes, all contributing to the inflammatory process and they activate or sensitize the nociceptors. Some released substances act by releasing another one (eg, bradykinin activates both Aδ and C nerve endings and increases synthesis and release of prostaglandins). Prostaglandin E 2 (a cyclooxygenase metabolite of arachidonic acid) is released from damaged cells and produces hyperalgesia. This is why aspirin and other NSAIDs (inhibitors of cyclooxygenase) alleviate pain. In addition to sensitization of nerve endings by chemical mediators, several other changes occur within the periphery and CNS that can contribute to the chronic pain. The NGF released by tissue damage is picked up by nerve terminals and transported retrogradely to cell bodies in dorsal root ganglia where it can alter gene expression. Transport may be facilitated by the activation of TrkA receptors on the nerve endings. In the dorsal root ganglia, nerve Growth factors increases production of substance P and converts non-nociceptive neurons to nociceptive neurons (a phenotypic change). Nerve growth factors also influences expression of a tetrodotoxin-resistant sodium channel (Nav1.8) on dorsal root ganglia, further increasing activity. Damaged nerve fibers undergo sprouting, so fibers from touch receptors synapse on spinal dorsal horn neurons that normally receive only

nociceptive input (see below). This can explain why innocuous stimuli can induce pain after injury. The combined release of substance P and glutamate from nociceptive afferents in the spinal cord causes excessive activation of NMDA (n-methyl-D-aspartate) receptors on spinal neurons, a phenomenon called "wind-up" that leads to increased activity in pain transmitting pathways. Another change in the spinal cord is due to the activation of microglia near afferent nerve terminals in the spinal cord by the release of transmitters from sensory afferents. This, in turn, leads to the release of pro-inflammatory cytokines and chemokines that modulate pain processing by affecting presynaptic release of neurotransmitters and postsynaptic excitability. There are P2X receptors on microglia; antagonists of these receptors may be a useful therapy for treatment of chronic pain.

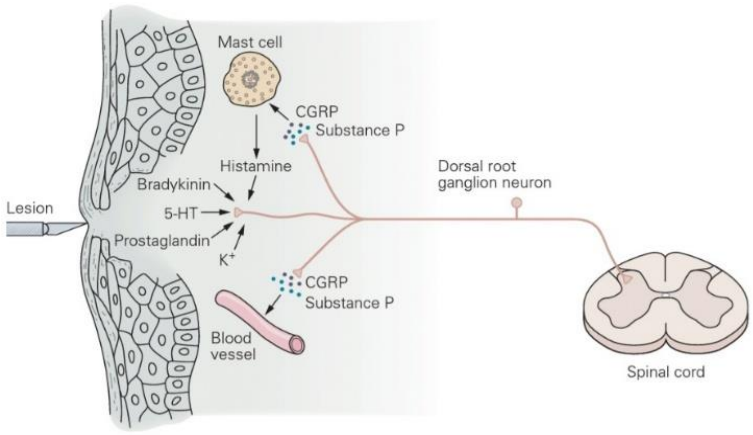


FIGURE 8–5 Chemical mediators are released in response to tissue damage and can sensitize or directly activate nociceptors. These factors contribute to hyperalgesia and allodynia. Tissue injury releases bradykinin and prostaglandins that sensitize or activate nociceptors, which in turn releases substance P and calcitonin gene-related peptide (CGRP). Substance P acts on mast cells to cause degranulation and release histamine, which activates nociceptors. Substance P causes plasma extravasation and CGRP dilates blood vessels; the resulting edema causes additional release of bradykinin. Serotonin (5-HT) is released from platelets and activates nociceptors. (From Lembeck F:CIBA Foundation Symposium, London: Pitman Medical; Summit, NJ, 1981.)

Fig.11 Chronic pain mediators

Clinical presentation

Symptoms of inguinodynia post-op, vary in degree of involvement of the nerve or nerves, proportional to mesh-related fibrosis and damage to spermatic cord structures. The neuropathic symptoms include neuralgia, paraesthesia, hypoesthesia and hyperaesthesia. The pain may also radiate to the hemi-scrotum, upper leg or back.

Neuropathic pain, usually characterised by a trigger point, episodic nature, is usually aggravated by walking or sitting. Various presentation like a stabbing, burning, shooting or pricking sensation is one manifestation. In contrast, non-neuropathic pain is usually a constant dull-ache over the entire groin area having no specific trigger points. It is usually aggravated by strenuous exercise. It is described as a gnawing, tender, pulling or pounding sensation.

It may also present as a numbness over the groin or thigh, the most common point of maximal tenderness at the pubic tubercle. They are associated with inflammation of the pubic tubercle either due to stitches made on the pubic bone during open repair or by tacks in laparoscopic repair. Another range of symptoms are related to sexual dysfunction due to vas engulfment and inflammatory reaction caused by the mesh. There is also ejaculatory pain in the region of superficial ring or testicular or labial pain due to geniotofemoral nerve

irritation. Patients also have complaints such as diminished quality of life, mood swings and depression.

Measuring inguinodynia by neuropathic scales

Neuropathic scales are questionnaire designed to identify inguinodynia. Scores are given for each and the final calculation is done.

Neuropathic Pain Questionnaire - short form (NPQ-S)

The NPQ contains 12 items to help differentiate neuropathic pain patients from nonneuropathic pain patients. From a preliminary 32-item questionnaire, the final NPQ contains 12 items. The 12-item questionnaire has 66.6% sensitivity, 74.4% specificity, and 71.4% accuracy. A stepwise discriminant analysis of the 12 NPQ items identified 3 items as significant predictors. These included tingling pain, numbness, and increased pain due to touch. From these 3 items, the authors offered a short form of the NPQ . The NPQ short form has 64.5% sensitivity, 78.6% specificity, and 73% accuracy.

The Neuropathic Pain Questionnaire – Short form (NPQ-S) was originally developed in the United States as from a discriminative analysis of the 12 NPQ questions. Among these, three were considered significant to differentiate neuropathic from non-neuropathic pain, [Fig.4] namely: 1. Is your pain tingling? 2.

Do you feel numbness at pain site? 3. Is pain worsened with touch? Discriminative function of this tool was able to estimate 64.5% sensitivity and 78.6% specificity and total forecast accuracy of 73.0%

1sf. Numbness: rate your usual pain:

0 ◄——————————► 100

No Numbness Sensation	Worst Numbness Imaginable

2sf. Tingling pain: rate your usual pain:

0 ◄——————————► 100

No Tingling Pain	Worst Tingling Pain Imaginable

3sf. Increased pain due to touch: rate your usual pain:

0 ◄——————————► 100

No Increase At All	Greatest Increase Imaginable

Scoring Worksheet:

Item		Score	Coefficients	Product
1sf.	Numbness	_____	.017	_____
2sf	Tingling Pain	_____	.015	_____
3sf	Increased Pain due to Touch	_____	.011	_____
				_____
	Constant			-1.302
Total Discriminant Function Score:			=	_____

Discriminant Function Score Below 0: _____ Predicts **Non-Neuropathic Pain**
Discriminant Function Score at or Above 0: _____ Predicts **Neuropathic Pain**

Fig.12 The Neuropathic Pain Questionnaire – Short form (NPQ-S)

Predictors of inguinodynia

Prachi et al did a study to evaluate the prediction of inguinodynia. Here the Univariate analysis demonstrated that age, smoking at the time of the operation (within six weeks), history of a prior contralateral repair, laparoscopic repair, and patients who had a postoperative complication were more likely to have inguinodynia. Younger age (54 years-old vs. 61 years-old; odds ratio = 0.96), smoking at the time of the operation (OR = 4.4), history of a prior contralateral repair (OR = 5.4), laparoscopic approach (OR = 15.2), and a postoperative complication (OR 5.1) were independent predictors of inguinodynia

Patients' modulators of nociceptive information

Modulators of nociceptive information represent the patients' characteristics or features. They are roughly divided into genetics, age, memory of pain, mental and activity state.

The most obvious example of the influence of genetic disorders on pain is a gene mutation that results in dysfunction of the sodium channels in the cell resulting in insensitivity for pain. Also, there is some evidence that genetic polymorphisms are associated with a greater risk to develop chronic pain. For back pain, additive genetic effects were found to be modest contributors in male twins.47 Genetic variations in a gene that encodes for Catechol-O-Methyl

Transferase (COMT) and the human-mu-receptor were found to be associated with differences in pain sensation.48, 49, 50 Gene therapy is already successfully applied in chronic pain treatment.51, 52 Assessment of genetic profiles may be usable to predict therapy outcome.

Age is regarded as an independent inverse determinant.7, 53, 54 The elderly seem to rely predominantly on C-fibre input whereas younger adults have additional input from A-delta fibres. This results in a decreased function of the nociceptive sensation and an increased pain/heat perception threshold in the elderly.55, 56 Furthermore, psychosocial variables may alter during aging and influence pain perception (experience). The lower pain scores in the elderly may be disturbed by pain measurement using the visual analogue scale, on which the elderly tend to underscore their pain.57

Chronic pain is more often found after repair of recurrent hernias than after primary repair.7, 44 More extensive dissections and a higher risk of nerve damage following previous hernia repair and previous lower abdominal surgery may be responsible. But pain memory may also be of importance, since more chronic pain syndromes are found in patients with severe inguinodynia.8 These patients may also suffer from pathologic pain perception. Descending pain modulation may play a key role: the pain-facilitating system may be activated but not turned off, rather promoting than inhibiting spinal neuron activity.

The mental state can be of influence on endogenous opiates and neural substrates and thereby on the sensation of pain.58, 59Catastrophizing is a disorder that leads to inability to tolerate pain or thoughts that pain is unbearable.58, 60, 61, 62 The presence of catastrophizing thoughts might be associated with pain in hernia repair patients as it was in breast surgery and dental procedure patients.62 The same applies for depression, finding evidence in chronic pelvic and back pain. It remains unclear whether the pain contributes to the depression or the depression to the pain.

Anxiety is another psychological variable and can be divided into state and trait anxiety. State anxiety is a transitory state which varies in intensity and fluctuates over time, and trait anxiety can be defined as a personality disposition which remains relatively stable over time. State anxiety was found to be a predictor of postoperative pain in abdominal hysterectomy,63, 64 as it was following other abdominal surgery.61 Anxiety and catastrophizing are reactions associated with fear of pain.61, 65 Fear of pain was found to be related with the intensity of pain in a study wherein volunteers were administered a cold pressor procedure. The elevated fear of pain was hypothesized to induce avoidance behaviour, which in turn leads to a disuse syndrome, chronic disability and an exaggerated pain perception.

Interventions to the mental state, for example decreasing anxiety and subsequent pain have been investigated.66, 67, 68, 69, 70 Listening to music during and after a hernia repair leads to a reduction in pain.66, 67 Preoperative administration of anxiolytic benzodiazepines, however, had a minimal reductive effect on patient-controlled analgesia use.68 Intervention of a nurse telephoning patients postoperatively with advice and support resulted in less pain.69 The intervention of adequate preoperative information has been investigated in paediatric hernia repair. Patients experienced less postoperative pain if the parents were provided with information about the surgery.70 The combination of sensory information (description of the sensations that the patients likely will experience) and procedural information (emphasizes the sequence of medical procedures) yielded the strongest benefits in terms of reducing negative affect and pain reports in a meta-analysis.71

Employment has been reported to be an influencing factor to chronic pain; however, it might be biased by age and physical activity

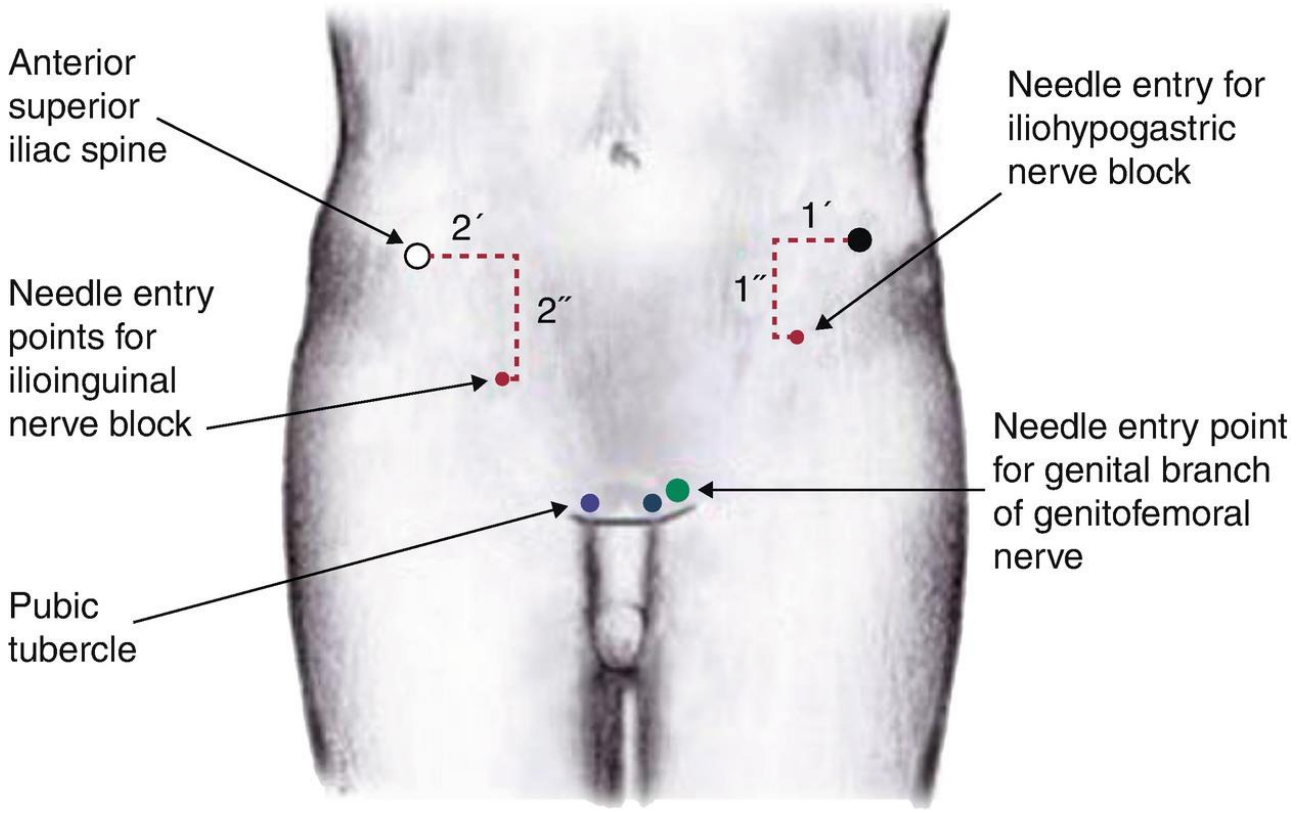


Fig.13 – Non operative management of inguinodynia

Prevention of inguinodynia

Non-fixation or inadequate mesh fixation causes folding, rolling of the mesh. This can cause chronic pain and recurrence of the hernia. Accidental division of the nerves also leads to chronic pain after mesh hernioplasty due to neuroma formation. The ilioinguinal, iliohypogastric, and genitofemoral nerves must be visualized and protected throughout the operation. Avoidance from being dissected free from their natural bed can prevent the sequel of perineural fibrosis and chronic pain postoperatively. Sometimes deliberate sectioning of the nerves intraoperatively to prevent chronic groin pain has been described though still controversial. Current recommendations consist of nerve identification, minimal handling, and preservation.[57] Prevention of nerve injury is very important as treatment of chronic neuralgias may not be successful.

Entrapment of a nerve by suture or mesh, an important cause of postoperative pain, leads to the fact that groin nerves should be identified and protected. Fibrin or biologic glues can also be used instead of sutures to secure the mesh. Cyanoacrylate glue may be a viable alternative to sutures, moreover, it is anticipated that the use of fewer sutures may be associated with less inguinodynia.[25]

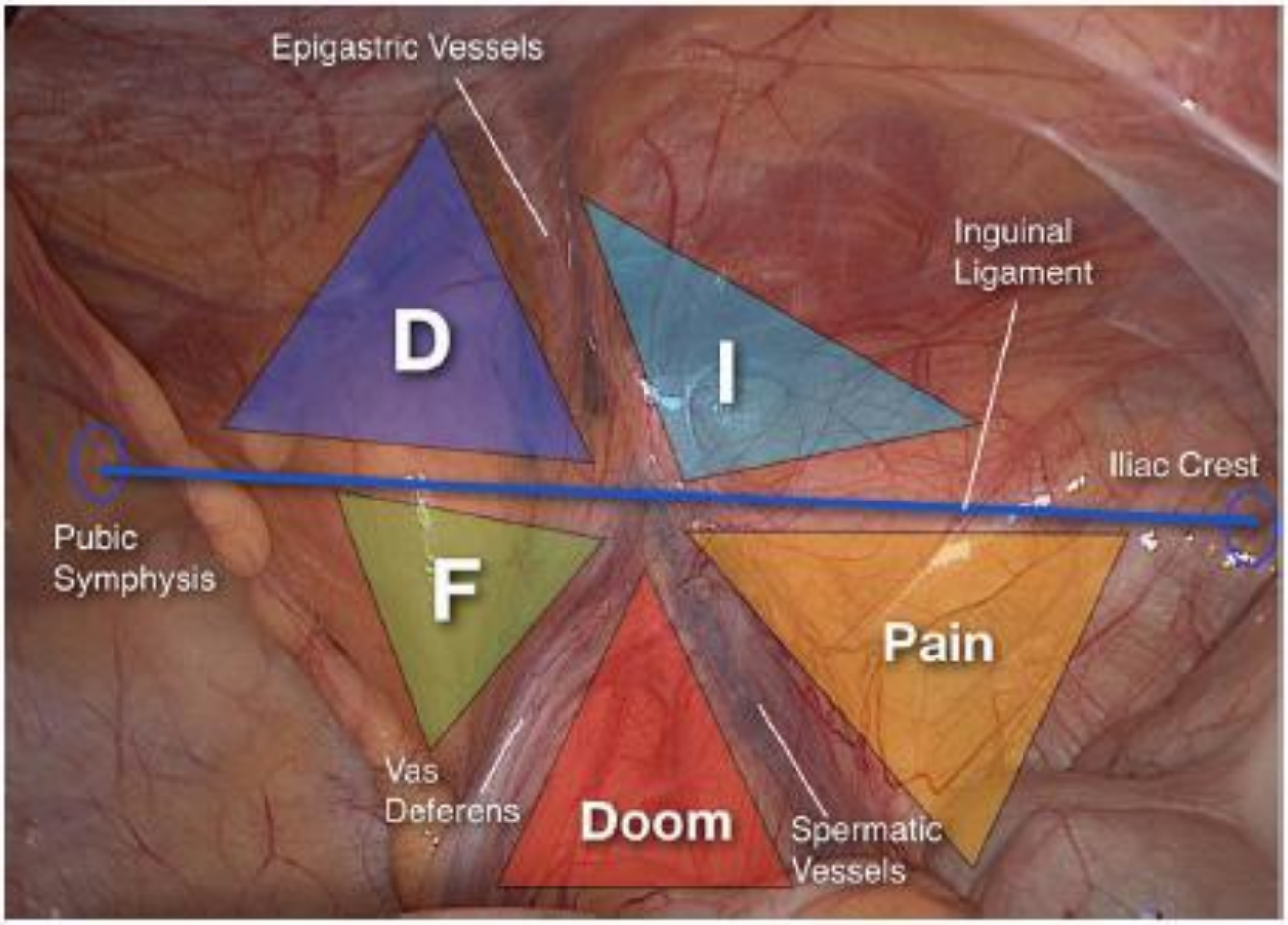


Fig.14 Identification of nerves - TAPP

Another cause of significant inguinodynia is a stitch into the periosteum at the pubic tubercle, done for fixation of the mesh medially. This is often the point of maximal tenderness postoperatively. Thus, one should avoid taking a deep bite through the periosteum of the pubic tubercle; tough, fibrous tissue in that region should be used instead for fixing the mesh. A low-density macroporous mesh with semiresorbable, self-fixing properties during tension-free repair may be a satisfactory solution to the clinical problems of pain and recurrence after inguinal herniorrhaphy. [58]

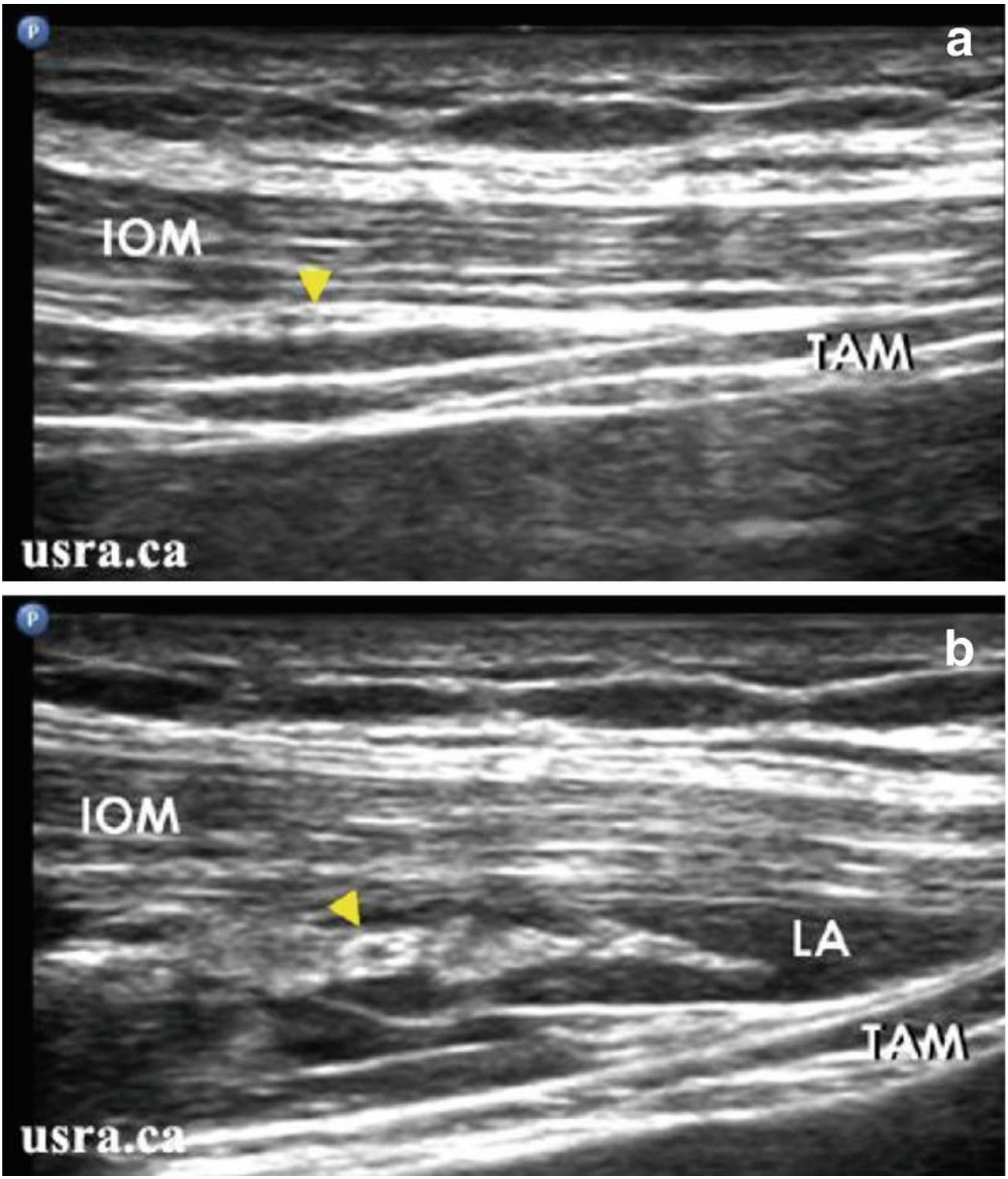


Fig.10 USG image of nerves

TREATMENT OPTIONS FOR CHRONIC GROIN PAIN

The treatment of inguinodynia is a tedious task for both the patient and the clinician. Many algorithms have been put forward, but none of them has been proved in randomised trials. Pain related to neuropraxia, is usually temporary and may resolve itself 6 months post-herniorraphy. As time progresses, inguinodynia disappears without treatment in 30% of the patients, persist mild in 45% and severe pain in 25% affecting their everyday life[5]. Analgesics, physiotheraphy, nerve block were used. But if all modality fails, surgery is resorted to.

SURGICAL TREATMENT

Stulz et al first described the surgical treatment of chronic groin pain in 1982. They performed ilioinguinal nerve neurectomy on 5 patients with chronic groin pain following inguinal hernia repair, achieving a 100% success rate. Surgical treatment is ultimately resorted to if refractory pain persists after treatment with oral analgesics, local nerve blockades. Nerve block reproduce a complete or substantial decrease in pain before recommendin a neurectomy. Surgery should ideally be resorted to only after at least 6 months after herniorraphy. This gives adequate time for any neuropraxia to settle and moreover medical management can be tried at this point [62].

Principles of surgical management

Removal of the mesh alone has not been shown to relieve inguinodynia. It is thought that it is due to chronic inflammation around the nerves from the mesh-induced reaction which usually leads to degenerative nerve damage. Traditionally, surgical treatment of inguinodynia includes groin exploration, mesh removal and neurectomy. Open chemical neurolysis has been tried, but it cannot resolve the problem of neuromas and secondary scarification[33]. Freeing the nerve alone causing physical neurolysis has been tried, but has high failure rates[27,53]. Simple division of the nerves without resection is not recommended. The entire length of the nerves should be excised, this involves all the neural connections between the nerves. Neurectomy with or without mesh excision is usually the preferred surgical treatment however, there are no current consensus on which surgical approach should be chosen and which nerve should be excised. A study by Heise et al[11] found that 62% of patients who had mesh removal plus neurectomy achieved excellent results in comparison with the mesh-removal-alone group where the success rate was 50%. Thus concurrent neurectomy affords better results than mesh removal alone. Radio-frequency ablation of inguinal nerves were recently used with the aim for ablating the painful impulses transmitted by injured nerves. Rozen et al[60] found that after radio-frequency ablation at T12,L1, L2

root level 4 out of 5 patients showed complete resolution of pain 4 to 9 months later. However, there is a lack of systematic evidence to support these findings.

The ilioinguinal nerve can be identified lateral to the internal ring and then traced towards the external ring and resected as distally as possible. The iliohypogastric nerve can be identified by the separation of the external oblique aponeurosis from the underlying internal oblique muscle as proximally as possible. With the iliohypogastric nerve, dissection should include the intramuscular section, in order to look for nerve entrapped by sutures, mesh plugs or tacks. The genitofemoral nerve is usually identified through a retro-peritoneal. In a very rare case of lateral femorocutaneous nerve involvement, decompression was performed by releasing the inguinal ligament on the anterior superior iliac spine (ASIS) and the lateral fibres of internal oblique aponeurosis[27].

Amid utilised the anterior approach, where the nerve could be identified within the lateral crus of the internal ring, within the internal ring or between the spermatic cord and the inguinal ligament. He demonstrated that although complete resection might not be possible with this approach, even partial resection is sufficient if the other 2 nerves are resected completely[54]. He devised a single stage procedure, where simultaneous ilioinguinal nerve, iliohypogastric nerve and genitofemoral nerve neurectomies were performed under local anaesthetic with

proximal end implantation of these nerves. Amid also devised a technique of implantating the cut end of the ilioinguinal nerve and iliohypogastric nerve within the fibres of the internal oblique, reducing the risk of adherence with aponeurotic structures and thereby reducing the chance of recurrent pain[36]. For genitofemoral nerve, the nerve was cut under tension in order to retract the nerve into the internal ring. Retrospective review of 225 patients who underwent surgery for neuropathic and non-neuropathic inguinodynia, 57% had perineural fibrosis, 11% had traumatic neuroma and 32% had nerve entrapment by suture, staple or mesh [36]. There was complete improvement in 85% of their patients, 15% of them had transient insignificant pain with no functional impairment. Four of the 225 patients had no benefit from this triple neurectomy[36]. [55] Laparoscopic triple neurectomies, performed by Krähenbühl et al using a retro-peritoneal approach resulted in a complete cure in three patients. Ducic et al with his open inguinal approach to identify the genitofemoral nerve postero-lateral to the cord, traced the nerve from there all the way to the pre-peritoneum and resected it under tension. They showed 100% pain relief in 4 patients treated with genitofemoral nerve neurectomy.

In every case, the resected nerve must be confirmed by histopathology. Patients must also be aware of post-neurectomy numbness in the area of corresponding nerve innervation.

The transacted nerve can be ligated, cauterised or buried within the muscle fibres. (Most commonly the internal oblique muscle). So far, there are no long-term results available from large studies regarding the safety of surgical mesh removal along with or excluding neurectomy. If there is an associated pubic periosteal reaction or osteitis, then possible agents such as suture materials, staples or rolled up meshes which are suspected to cause it should be removed. Steroid injection may be useful if used intra-operatively or post-operatively if pain persists[62].

MATERIALS AND METHODOLOGY

Study design:

This is a retrospective cross sectional study

Study period:

January 2018 to January 2019

Source of data:

All the patients, who have presented to the Department of General and GI Surgery, PSG Hospitals, Coimbatore, with complaints of swelling in the groin region – diagnosed as inguinal hernia and underwent hernioplasty using mesh (Laparoscopic TAPP and TEP, Open Lichtenstein hernioplasty) in our institution, during the period between January 2012 and June 2018, and those who have met the inclusion criteria, were included in this study.

Method of collecting data:

The data for this study was collected from the 180 subjects fulfilling the inclusion/exclusion criteria, who came to PSG Hospitals attending Surgery OPD for complaints of inguinal hernia during the study period January 2012 to June 2018, using a proforma specially designed for this study.

Sample Size:

Assuming a power of the study at 95% and p value of 0.05, we have calculated a sample size of 180 in each arm of the trial. We have calculated the same assuming a mean incidence of 62.5% deriving from previous studies.

Considering that there could be patients, who are unwilling to participate in the study and who do not meet the inclusion criteria, the total sample size is kept at 180.

Inclusion criteria:

1. Age group between 25 to 90
2. Study participants operated between January 2012 to June 2018.
3. Patients who had undergone hernioplasty using mesh (Laparoscopic TAPP and TEP, Open Lichtenstein hernioplasty) in our institution

Exclusion criteria:

1. Those patients where emergency hernia repair for obstruction or gangrene was performed
2. Hernioplasty is not a pure mesh repair e.g. Bassini's repair or hybrid procedure,

Methodology:

1. Patients diagnosed as a case of inguinal hernia who underwent hernioplasty in our institution were identified.
2. Subjects fulfilling the inclusion criteria are selected and informed
3. consent obtained via phone call interview after obtaining consent for telephonic interview
4. Subjects divided into 3 groups as Laparoscopic TAPP and TEP, and Open Lichtenstein hernioplasty. As per the surgery they underwent.
5. Those with inguinodynia were identified as patients with any discomfort in the surgical site in the groin whish was persisting after 3 months of hernioplasty.
6. Those who had groin pain were further assessed using the neuropathic pain questionnaire.
7. Those who satisfied the questionnaire were classified as inguinodynia
8. Results were calculated and tabulated

1sf. Numbness: rate your usual pain:

0 ⟷ 100	
No Numbness Sensation	Worst Numbness Imaginable

2sf. Tingling pain: rate your usual pain:

0 ⟷ 100	
No Tingling Pain	Worst Tingling Pain Imaginable

3sf. Increased pain due to touch: rate your usual pain:

0 ⟷ 100	
No Increase At All	Greatest Increase Imaginable

Scoring Worksheet:

Item		Score	Coefficients	Product
1sf.	Numbness	_____	.017	_____
2sf	Tingling Pain	_____	.015	_____
3sf	Increased Pain due to Touch	_____	.011	_____
				_____
	Constant			-1.302
Total Discriminant Function Score:			=	_____

Discriminant Function Score Below 0: _____ Predicts **Non-Neuropathic Pain**
Discriminant Function Score at or Above 0: _____ Predicts **Neuropathic Pain**

9.

Fig.9 The Neuropathic Pain Questionnaire – Short form (NPQ-S)

Outcome studied:

1. The primary outcome studied, was the prevalence of inguinodynia
2. The secondary outcome was to see if there was any statistically significant difference among the 3 techniques employed for the treatment of inguinal hernia

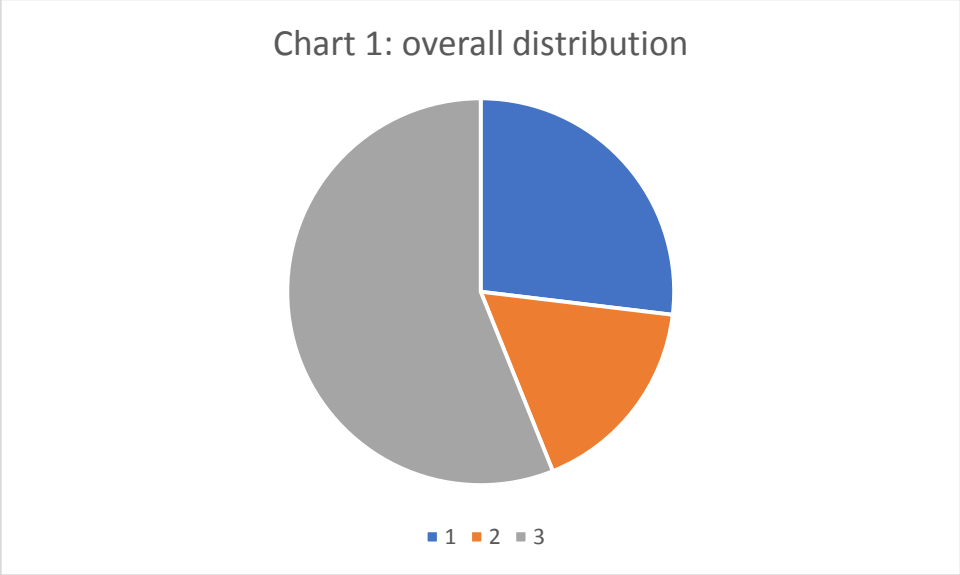
Table.1: Data collection tool

Sl No	Age	Gender (M/F)	Ip/op number	Date of surgery	Type of surgery (open/TEP/TAPP)	Type of mesh used	Pain persisting after 3 months (Y/N) Inguinodynia (neuropathic and non-neuropathic)	Nature of pain (neuropathic/not) Assessed using neuropathic pain questionnaire (Neuropathic inguinodynia)

RESULTS

In the study conducted, demographic data showed that off all the results as below.

Among the inguinal hernias, 49 (27.2%) were Laparoscopic Trans Abdominal repair (TAPP), 31 (17.2%) were Laparoscopic Totally extraperitoneal repair (TEP) and 102 (56.7%) were open inguinal hernioplasties, as shown in Chart 1 below.



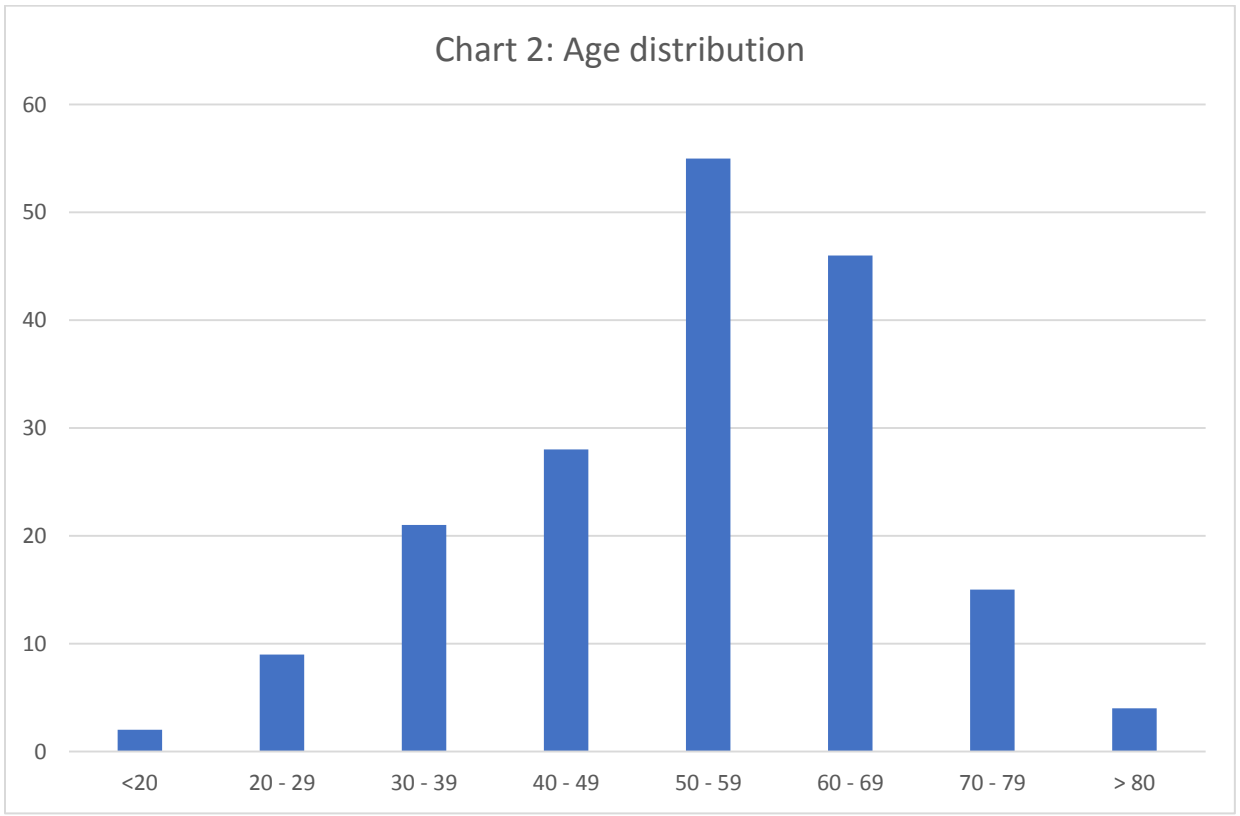
1.TAPP, 2. TEP, 3. Open

The mean age was 50 years. The youngest being 25 yrs and the oldest 73yrs. 65% of the affected age group being 45 to 65years. The prevalence was noted to be highest in the second decade, followed by the sixth decade. The least commonly

affected were the patients in the age group less than 20 years and more than 80 years.

Table. 2 – Age distribution

Age distribution	Total Cases	Inguinodynia	Percentage	Neuropathic	Percentage
age <20	2	0	0	0	0
20 - 29	9	3	33.3	3	33.3
30 - 39	21	3	14.3	1	4.7
40 - 49	28	7	25	3	10.7
50 - 59	55	12	21.8	5	9
60 - 69	46	12	26	5	10.8
70 - 79	15	2	13.3	1	6.7
age > 80	4	1	25	0	0



Among the study population, the only mesh that was used was a polypropylene mesh. It was a monofilament polypropylene non-absorbable, porous mesh, sterilized by ethylene oxide gas. It had a shelf life of 5 years. A few polyester meshes were also used, however the study participants with the polyester mesh could not be studied as some did not fit into the inclusion and exclusion criteria, and others were not willing for follow-up.

The next criterion compared was the type of hernioplasty done. Table.4 illustrates the overall distribution of the same.

Table. 3 – Overall prevalence among the types of hernioplasties

	cases	inguinodynia	%	Neuropathic inguinodynia	%
total no of cases	180				
Tapp unilateral	30	5	16.6	3	10
Tapp bilateral	17	4	23.5	1	5.9
TEP bilateral	9	2	22.2	1	11.1
TEP unilateral	22	7	31.8	3	13.6
Open bilateral	36	8	22.2	6	16.6
Open unilateral	66	13	19.7	4	6
total	180	39	21.6	18	10

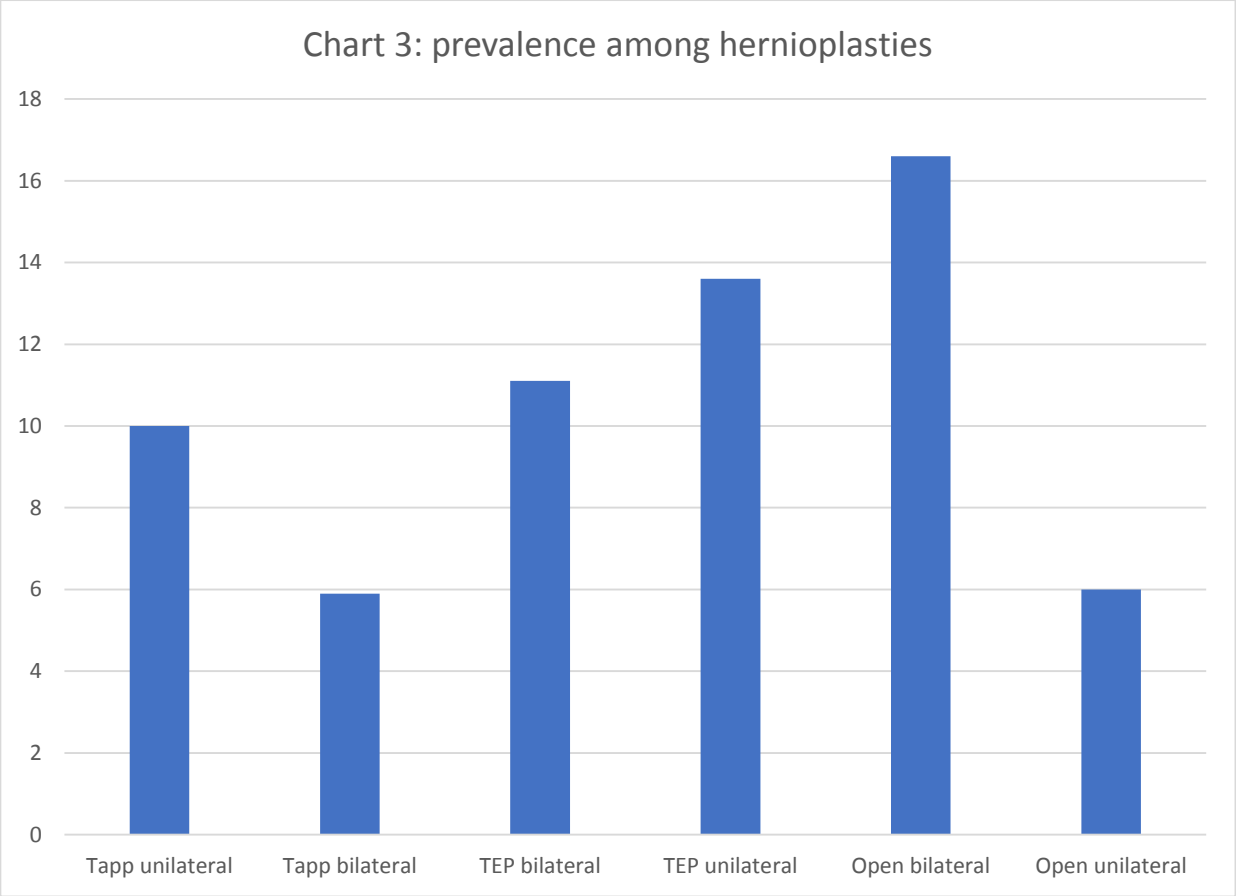
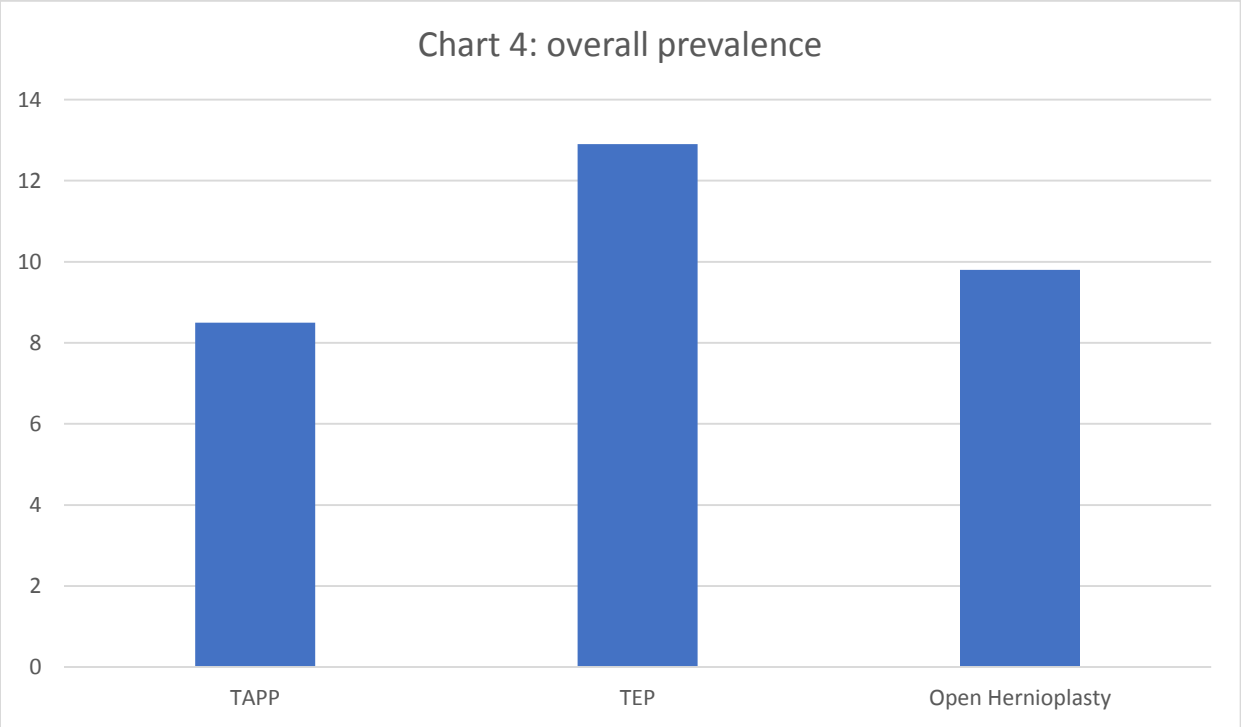


Table 4: PREVALENCE OF INGUINODYNIA - DISTRIBUTION

	Number of surgeries	Number of inguinodynia	Percentage of inguinodynia
TAPP	49	4	8.5
TEP	31	4	12.9
Open Hernioplasty	102	10	9.8



The overall distribution was similar as far as non neuropathic inguinodynia was considered. Among the cases, the highest prevalence was for unilateral Laparoscopic TEP repair technique, and the lowest was for unilateral laparoscopic hernia repair TAPP. Non neuropathic inguinodynia was noted to be more in laparoscopic hernioplasty compared to open repair techniques. The prevalence distribution changes when neuropathic inguinodynia was considered. The least rates were for unilateral open inguinal hernioplasty, and the highest rates were for bilateral open hernioplasty. Here the prevalence in laparoscopic repair seemed to be lower compared to open techniques. Neuropathic pain being more specific for inguinodynia, the prevalence of bilateral open hernioplasty was the highest, and unilateral open hernioplasty was the lowest.

Comparing all 3 methods, the prevalence was found to be highest for Laparoscopic hernioplasty TEP, and least for laparoscopic TAPP.

In order to denote the significance, statistical analysis was done using SPSS software employing Chi square test as a test of statisticical significance. The results were tabulated as given in table. 5

Table 5: CHI-SQUARE ANALYSIS

Hernia repair types	**Inguinodynia**		**P value**
	n	%	
TAPP	4	8.50%	0.814
TEP	4	12.90%	0.821
Open Hernioplasty	10	9.80%	0.885

The sample size for this study was 180 with 102 patients undergoing open hernioplasty, 47 TAPP and 31 TEP respectively. Among the 180 patients, 18 had significant inguinodynia. This calculates to a 8.5%, 12.9% and 9.8% for TAPP, TEP and Open Hernioplasy (Table.1). Chi square test was used to calculate the p value and a value of less than 0.05 was considered statistically significant. The p values for TAPP, TEP and open repair were 0.814, 0.821, 0.885 Respectively,(Table.2) which was not statistically significant.

Male and female ratio could not be compared as we did not have female patients who had undergone hernioplasty during the study period.

The prevalence of inguinodynia according to this study was 10%. There was no statistically significant difference among the 3 methods of hernioplasty as far as inguinodynia was concerned.

DISCUSSION

This retrospective cross sectional study was conducted to find the prevalence of inguinodynia in patients undergoing hernioplasty in our institution. It is well known that recurrence is a major cause of morbidity that determines the post op satisfaction in hernioplasty. However inguinodynia is another factor which contributes a lot to the morbidity. Hence the percentage of inguinodynia determines the technique of hernioplasty surgery.

Fränneby et al in his study, listed the possible factors which can contribute to inguinodynia. Factors such as age below median, absence of a visible bulge prior to the operation, recurrent hernia repair, and history of moderate to severe pre-operative groin pain, are some of the common factors that influence the post-operative inguinodynia. Breach of surgical technique, nerve entrapment, poor mesh placement, osteitis pubis, compromise of spermatic cord, plug repair with secondary concrete-like mass, inappropriate tack placement laparoscopically or suture placement with open technique, loss of domain, neuropathy secondary to exaggerated scarification response, and possible neuropathy from resultant scarification, post-op infection or fistulization or sinus formation, idiosyncratic response to mesh implantation, infected mesh-toxic shock syndrome,

inflammatory or irritable bowel disorde and gynecological causes are some of the other causes

The factors studied here were age group, sex, mesh type and surgical technique.

Age:

Manangi. et al. study found that there was no relation between age and incidence of inguinodynia. Courtney, et al. found that the risk of inguinodynia was inversely proportional to age, from 39 to 58% in age group less than 40 years to 14-17% in age more than 65 years. Langeveld et al, stated that age group of 18-40 years, presented more frequently with inguinodynia than age group of 40-60 years. and elderly more than 60 years, 43% vs. 29% vs. 19% [7]. In our study however, the age group had an impact on inguinodynia with the second decade most common and the age group less than 20 and more than 80 with the least rates.

Gender:

Studies having gender-specific data showed the highest incidence in femaales. Mori et al. Did a study where 15% of 224 patients undergoing mesh hernia repair were women, in the end, three of the four patients with continuous pain were women. Incidence of chronic pain of 0.5% in males versus 8.8% in females [8]. A retrospective study consisting of 594 men and

56 women, i.e. 3% males and 11% female patients developed inguinodynia [9]. Bay–Nielsen M., et al. In his study, described women gender as an independent risk factor for the development of inguinodynia, possibly because females report the pain more due to a lower pain threshold [10]. Concluding, all these findings suggest female gender have a higher risk of developing inguinodynia. Our study however could not compare gender distribution as the study participants meeting the inclusion and exclusion criteria were only males during the time of study.

Type of mesh used:

The type of mesh placed is also another significant factor for inguinodynia. The majority of patients who present with chronic groin pain also suffer from foreign body sensation and stiffness in the groin area. Studies by Post et al and O'Dwyer et al cocncluded that pain may be caused by the composition and weight of implanted prosthetic material itself. Heavyweight polypropylene meshes like Prolene and polymer meshes with both polypropylene and polyglactin fibres like Vypro I and Vypro II increase the surface area of the mesh. This leads to extensive fibrosis and leads to a greater risk of infection and pain. An implant knitted from monofilament fibres, such as Ultrapro, composed of polypropylene and poliglecaprone absorbable fibres, causes less tissue reaction. However, light-weight meshes have shown promise in reducing the groin pain rate. Disadvantages

being early and mid recurrence rates possibility due to their lesser tensile strength. A randomised controlled trial comparing Heavy weight with light weight mesh showed higher incidence of groin pain for heavy weight mesh at 6 months follow-up i.e. 6.3% vs 0%, respectively which was statistically significant. Randomised controlled trials have shown that the feeling of foreign body sensation is higher in heavy weight mesh groups compared to light weight mesh: 43.8% vs 17.2% by Post et al and 32.8% vs 20.9% by Nikkolo et al. However, the follow-up in both these randomised control trials was only for 6 months, thereby the higher recurrence rates was not accounted as far as association with light weight meshes were concerned. O'Dwyer et al did a study where 162 patients were randomised in a light weight group and 159 in a heavy weight group and showed that the recurrence rate was higher in the former group (5.6% vs 0.4%) at 12 months follow-up, which was statistically significant. In our study however, the prevalence could not be compared as all the study participants used polypropelene mesh, and those with other mesh types did not meet the inclusion and exclusion criteria.

Types of hernioplasty technique:

There are a lot of controversies regarding the prevalence of inguinodynia and the type of hernioplasty. Various techniques of hernia repair were invented including herniorrhaphy, hernioplasty. The open hernioplasty technique had the least recurrence rates. However the inguinodynia as per studies were found to be at a higher rate compared to non-mesh techniques. Bueno, et al did a study to compare the rate and characteristics of postoperative neuralgia after 2 methods of inguinal hernia repairs. 400 inguinal hernia repairs were performed between July 1997 and December 2000, and patients were followed up in a prospective trial about postoperative nerve irritations. There were no significant differences in pain characteristics according to clinical type of hernia. The TAPP method had less rate of postoperative inguinal neuralgia compared to Lichtenstein repair. This emphasised more persistent discomfort in anterior approach than laparoscopic repair. A controversy as per study by Abdulkareem, where, in his study highlighted that a metanalysis done in Britain showed no statistically significant difference between laparoscopic vs open hernioplasties.

In our study, 8.5%, 12.9% and 9.8% was the prevalence for TAPP, TEP and Open Hernioplasy. The p values for TAPP, TEP and open repair were 0.814, 0.821, 0.885 Respectively, which was not statistically significant.

The data present in the literature assessing the incidence of chronic pain are quite different. This can be attributed to different definitions, different methods of measurement, different moments of evaluation, and the subjectivity of pain, a symptom viewed in different ways by different peoples and cultures. For this reason, the most recent data on the subject are based on the international guideline for diagnosis and management of inguinodynia after inguinal hernia surgery, published in 2011.This aims to standardize some basic concepts on the theme. The incidence varies among studies, ranging between 0% and 62.9%, with 10% of patients fitting in the moderate to severe pain group[2-6]. However, only 2%-4% of the patients are adversely affected by inguinodynia in their everyday life. This is significant, considering the volume of the operations performed worldwide [45]. Originally, the supposed culprit causing the neuropathy was believed to be the mesh per se. This gave the senior surgeons probable cause to condemn the use of mesh and continue the archaic Bassini, McVay, or other non-mesh repairs. Subsequent research, however, showed that the mesh did not cause the neuropathy but, instead, was traced to the surgeon's surgical technique. With the use of mesh, more detailed anatomic dissection and attention to sensory nerve anatomy was required. Surgeons were the one actually incorporating the sensory nerve with the suture used to fix the mesh. This is the one causing the neuropathy. Avoiding the sensory nerve during dissection, reduces greatly the incidence of neuropathy.

Recognition of the precise anatomy of the ilioinguinal, iliohypogastric, genitofemoral, and lateral femoral cutaneous nerves is thus paramount. Symptoms emanating from the neuropathy generally resolve spontaneously in a few months only if the neuropathy is from inflammation.

In this study however, the prevalence was 10%, and there was no statistically significant difference between the 3 different methods of hernioplasties. None of the patients in the study population needed mesh removal

CONCLUSION

As per this cross sectional study, the prevalence of inguinodynia Is 10%. There is no statistically significant difference in the overall technique of hernioplasty employed. None of the patients in the study population needed mesh removal.

LIMITATIONS

1. The gender prevalence could not be calculated, as the patients did not meet the inclusion exclusion criteria
2. The prevalence among the different types of mesh could not be evaluated.
3. Convenient method of sampling was used.

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ANNEXURES

Table.1: Data collection tool

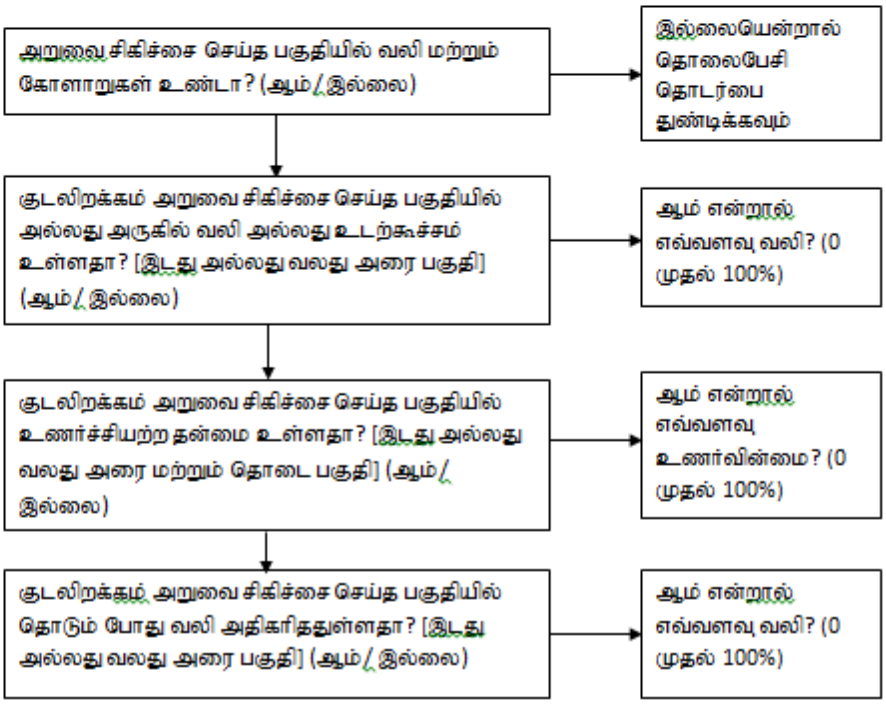
Sl No	Age	Gender (M/F)	Ip/op number	Date of surgery	Type of surgery (open/TEP/TAPP)	Type of mesh used	Pain persisting after 3 months (Y/N) Inguinodynia (neuropathic and non-neuropathic)	Nature of pain (neuropathic/not) Assessed using neuropathic pain questionnaire (Neuropathic inguinodynia)

INFORMED CONSENT – PATIENT INTERVIEW via PHONE CALL - TAMIL

வாய்மொழி ஒப்புதல்

- பி.எஸ்.ஜி மருத்துவமனை, பொது அறுவை சிகிச்சை பிரிவிலிருந்து மருத்துவர் வினோத்
- குடலிறக்கம் (Inguinal hernia) அறுவை சிகிச்சை செய்து கொண்டதினால் தொடர்ந்து நீண்டகாலமாக ஏதாவது தொந்தரவு இருக்கிறதா என்பதை அறிந்து கொள்ள ஒரு ஆய்வு.
- பி.எஸ்.ஜி மருத்துவமனையில் 3 மாதங்களுக்கு முன் நீங்கள் அறுவை சிகிச்சை செய்து கொண்டபடியினால் உங்களிடம் கருத்து கேட்கப்படுகிறது.
- அதிகபட்சம் உங்களிடம் 7 கேள்விகள் கேட்கப்படும்.
- பிற்காலங்களில் குடலிறக்கம் (hernioplasty) செய்வதில் சில முன்னேற்றங்களை கொண்டுவர இந்த ஆய்வு உதவி செய்யும்.
- உங்களுடைய அரை பகுதியில் நீண்டநாளாயிருக்கும் வலிக்கு தீர்வு காண இது உதவி செய்யும்.
- உங்களுக்கு விருப்பம் இருந்தால் நீங்கள் இதில் பங்கு கொள்ளலாம்; இல்லையென்றால் பிரச்சனை ஏதுமில்லை.
- இதில் பங்கு கொள்ள உங்களுக்கு விருப்பம்தானா?

கேள்விகள் குடலிறக்கம்



INFORMED CONSENT VIA PHONE CALL - ENGLISH

Questionnaire:

1. Do you have any pain in the operated site? (Y/N)
2. Do you have any tingling pain in the near the operated hernia site [left or right groin] (Y/N)
3. If yes, how much pain? (0 to 100%)
4. Do you have any Numbness near the operated hernia site [left or right groin and thigh] (Y/N)
5. If yes, how much Numbness? (0 to 100%)
6. Do you have any increased pain when you touch the operated hernia site [left or right groin] (Y/N)
7. If yes, how much pain? (0 to 100%)

PSG Institute of Medical Sciences & Research
Institutional Human Ethics Committee

Recognized by The Strategic Initiative for Developing Capacity in Ethical Review (SIDCER)
POST BOX NO. 1674, PEELAMEDU, COIMBATORE 641 004, TAMIL NADU, INDIA
Phone : 91 422 - 2598822, 2570170, Fax : 91 422 - 2594400, Email : ihec@psgimsr.ac.in

PSG/IHEC/2018/Amend/001 March 12, 2018

To
Dr D Vinoth
Postgraduate
Department of General Surgery
Guide: Dr S Rajesh Kumar
PSG IMS & R
Coimbatore

The Institutional Human Ethics Committee PSG IMS & R, Coimbatore - 4, has reviewed your proposal on 9th March, 2018 in its expedited review meeting held at IHEC Secretariat, PSG IMS&R, between 10.00 am and 11.00 am, and discussed your request to amend the study entitled:

"Prevalence of inguinodyia in patients undergoing hernioplasty in a tertiary care hospital, Coimbatore: a cross-sectional study"

The following documents were received for review:

1. Amendment reporting form dated 05.03.2018
2. Status report

After due consideration, the Committee has decided to approve your request to interview the patients using a neuropathic pain questionnaire via phone call (after obtaining oral consent and audio record the same) for the above study.

The members who attended the meeting held on at which your proposal was discussed, are listed below:

Sl. No.	Name of the Member of IHEC	Qualification	Area of Expertise	Gender	Affiliation to the Institution Yes/No	Present at the meeting Yes/No
1	Mr R Nandakumar (Chairperson, IHEC)	BA., BL	Legal Expert	Male	No	Yes
2	Dr D Vijaya (Member – Secretary, IHEC)	M Sc., Ph D	Basic Medical Sciences (Biochemistry)	Female	Yes	Yes
3	Dr S Shanthakumari	MD	Pathology, Ethicist	Female	Yes	Yes
4	Dr Sudha Ramalingam	MD	Epidemiologist, Ethicist Alt. member-Secretary	Female	Yes	Yes
5	Dr G Subhashini	MD	Epidemiologist	Female	Yes	Yes

This Ethics Committee is organized and operates according to Good Clinical Practice and Schedule Y requirements.

Non-adherence to the Standard Operating Procedures (SOP) of the Institutional Human Ethics Committee (IHEC) and national and international ethical guidelines shall result in withdrawal of approval (suspension or termination of the study). SOP will be revised from time to time and revisions are applicable prospectively to ongoing studies approved prior to such revisions.

Kindly note this approval is subject to ratification in the forthcoming full board review meeting of the IHEC.

Yours truly,

12/3/2018

SECRETARY
PSG IMS&R
COIMBATORE-641004
INSTITUTIONAL HUMAN ETHICS COMMITTEE

Dr D Vijaya
Member – Secretary
Institutional Human Ethics Committee

Proposal No. 17/367 dt.12.03.2018, Title: Prevalence of inguinodyia in patients undergoing hernioplasty in a tertiary care hospital, Coimbatore: a cross-sectional study

MASTER CHART

Op number	Ip number	Age/Sex	Date of Surgery	Type	Mesh	pain	inguinodynia
O18011928	I18007563	58/M	09-Mar-18	TEP (right)	prolene	no	no
O18017500	I18008792	65/M	20-Mar-18	TEP (right)	prolene	YES	no
O15063308	I19001197	19/M	12-Jan-19	Lap TEP (Right)	prolene	no	no
O18012163	I18006394	19/M	27-Feb-18	TAPP (left)	prolene	no	no
O18058074	I18029182	24/M	18-Sep-18	Lap TAPP (Left)	prolene	YES	YES
O18087413	I18042617	25/M	04-Jan-19	open (Right)	prolene	YES	YES
O18018597	I18009932	25/M	29-Mar-18	TAPP (Right)	prolene	no	no
O18026907	I18013799	26/M	05-May-18	Lap TEP (Right)	prolene	no	no
O19001517	I19000835	26/M	09-Jan-19	open (Left)	prolene	no	no
O12049487	I18005822	26/M	22-Feb-18	TAPP (Right)	prolene	YES	YES
O18045647	I18022871	27/M	24-Jul-18	Lap TAPP (b/l)	prolene	no	no
O18000097	I18000123	27/M	03-Jan-18	open (Right)	prolene	no	no
O18011092	I18010243	27/M	02-Apr-18	TAPP (left)	prolene	no	no
O17098701	I18018500	30/M	13-Jun-18	Lap TAPP (Left)	prolene	no	no
O09012782	I18021580	30/M	17-Jul-18	open (Left)	prolene	no	no
O18006598	I18003790	30/M	06-Feb-18	TEP (right)	prolene	no	no
O11065847	I18005668	31/M	20-Feb-18	TAPP (b/l)	prolene	no	no
O18064846	I18032719	32/M	16-Oct-18	Lap TAPP (left)	prolene	no	no
O18037294	I18021572	32/M	11-Jul-18	Lap TAPP (Right)	prolene	no	no
O17000467	I18030593	32/M	01-Oct-18	open (Right)	prolene	YES	no
O13067187	I18021214	33/M	09-Jul-18	Lap TAPP (Right)	prolene	no	no
O16076476	I18018441	34/M	13-Jun-18	Lap TEP (Right)	prolene	no	no
O18049197	I18028920	35/M	18-Sep-18	Lap TAPP (Right)	prolene	no	no
O18018734	I18014063	35/M	09-May-18	open (Right)	prolene	no	no
O08037013	I18014123	36/M	12-May-18	open (Right)	prolene	no	no
O08037013	I18014123	36/M	12-May-18	open (Right)	prolene	YES	no
O18080529	I18041192	36/M	22-Dec-18	open (Right)	prolene	no	no
O17096412	I18004736	36/M	14-Feb-18	TAPP (left)	prolene	no	no
O10035615	I18013736	37/M	10-May-18	open (Right)	prolene	no	no
O17074543	I18026182	38/M	21-Aug-18	Lap TEP (b/l)	prolene	no	no
O12029658	I18025422	38/M	14-Aug-18	Lap TEP (Right)	prolene	YES	YES
O18065730	I18034571	39/M	01-Nov-18	open (Right)	prolene	no	no
O18018209	I18009123	39/M	20-Mar-18	TAPP (left)	prolene	no	no
O18018517	I18010006	39/M	31-Mar-18	TAPP (left)	prolene	no	no
O18068069	I18037283	40/M	20-Nov-18	Lap TAPP (Right)	prolene	no	no
O18040712	I18021578	40/M	10-Jul-18	open (Right)	prolene	no	no

O18010981	I18008255	40/M	15-Mar-18	TAPP (Right)	prolene	YES	no
O18082706	I18040876	41/M	17-Dec-18	Lap TAPP (b/l)	prolene	no	no
O18084635	I18041929	41/M	27-Dec-18	Lap TAPP (Right)	prolene	no	no
O14007116	I18023053	41/M	27-Jul-18	Lap TEP (Right)	prolene	no	no
O16011131	I18029305	41/M	19-Sep-18	Lap TEP (Right)	prolene	no	no
O18052241	I18029991	42/M	22-Sep-18	Lap TEP (b/l)	prolene	no	no
O09061084	I18028244	42/M	07-Sep-18	Lap TEP (Left)	prolene	no	no
O18045950	I18022643	43/M	23-Jul-18	Lap TAPP (b/l)	prolene	no	no
O18009647	I18005270	43/M	17-Feb-18	TAPP (Right)	prolene	no	no
O18049198	I18029329	44/M	19-Sep-18	Lap TAPP (b/l)	prolene	YES	YES
O18044029	I18022911	44/M	25-Jul-18	Lap TEP (Right)	prolene	YES	YES
O18080965	I18040640	44/M	22-Dec-18	open (b/l)	prolene	no	no
O07080458	I18017973	44/M	12-Jun-18	open (Right)	prolene	no	no
O18072961	I18035779	45/M	14-Nov-18	open (Left)	prolene	YES	no
O17097487	I17054281	45/M	29-Dec-17	open (Right)	prolene	no	no
O18032131	I18018472	45/M	16-Jun-18	open (Right)	prolene	no	no
O17088258	I18002064	46/M	24-Jan-18	open (b/l)	prolene	no	no
O18012268	I18010461	46/M	04-Apr-18	open (b/l)	prolene	no	no
O16037876	I18017176	47/M	02-Jun-18	Lap TEP (Right)	prolene	YES	no
O18084388	I18041510	47/M	26-Dec-18	open (b/l)	prolene	no	no
O18075507	I18037650	47/M	27-Nov-18	open (Left)	prolene	no	no
O19000656	I19000415	47/M	08-Jan-19	open (Left)	prolene	no	no
O10026872	I18012434	47/M	24-Apr-18	open (Right)	prolene	YES	no
O16018991	I18025792	47/M	21-Aug-18	open (Right)	prolene	no	no
O17100245	I18000269	48/M	08-Jan-18	open (b/l)	prolene	no	no
O08078609	I18024831	48/M	10-Aug-18	open (b/l)	prolene	YES	YES
O18061077	I18030267	50/M	25-Sep-18	Lap TEP (Left)	prolene	no	no
O14060064	I18021241	50/M	07-Jul-18	Lap TEP (Right)	prolene	YES	no
O17092744	I17054127	50/M	22-Dec-17	open (b/l)	prolene	YES	YES
O17099896	I18022138	50/M	16-Jul-18	open (Left)	prolene	no	no
O18051786	I18026160	50/M	24-Aug-18	open (Left)	prolene	no	no
O18048548	I18038350	50/M	30-Nov-18	open (Right)	prolene	YES	no
O13039040	I18010715	50/M	07-Apr-18	TAPP (left)	prolene	no	no
O17091579	I17051617	51/M	01-Dec-17	open (b/l)	prolene	no	no
O16030730	I18017164	51/M	01-Jun-18	open (Left)	prolene	no	no
O18032149	I18015919	51/M	25-May-18	open (Right)	prolene	no	no
O12086557	I19000708	51/M	11-Jan-19	open (Right)	prolene	no	no
O13083647	I18012377	52/M	21-Apr-18	Lap TAPP (Right)	prolene	no	no
O18082771	I18040972	52/M	19-Dec-18	Lap TEP (b/l)	prolene	YES	no

O07072162	I18022920	52/M	23-Jul-18	Lap TEP (Left)	prolene	no	no
O18008162	I18004979	52/M	20-Feb-18	open (Right)	prolene	YES	no
O18086596	I19002125	53/M	23-Jan-19	Lap TEP (b/l)	prolene	no	no
O18043178	I18022926	53/M	27-Jul-18	Lap TEP (Left)	prolene	no	no
O13053806	I18010432	53/M	10-Apr-18	open (b/l)	prolene	no	no
O16045340	I17054033	53/M	22-Dec-17	open (Left)	prolene	YES	YES
O19001874	I19002259	53/M	24-Jan-19	open (Right)	prolene	no	no
O13080661	I18020234	54/M	29-Jun-18	open (Left)	prolene	no	no
O18045455	I18022493	55/M	24-Jul-18	Lap TAPP (b/l)	prolene	no	no
O18057725	I18028449	55/M	18-Sep-18	Lap TAPP (b/l)	prolene	YES	no
O18074921	I19000160	55/M	03-Jan-19	Lap TAPP (Right)	prolene	YES	YES
O17096453	I17053933	55/M	27-Dec-17	open (b/l)	prolene	no	no
O18014182	I18010738	55/M	07-Apr-18	open (b/l)	prolene	YES	YES
O17089620	I17055080	55/M	29-Dec-17	open (Right)	prolene	no	no
O17091427	I17051550	55/M	01-Dec-17	TAPP (b/l)	prolene	no	no
O17090776	I17053732	55/N	20-Dec-17	open (Right)	prolene	no	no
O18039200	I18019691	56/M	25-Jun-18	Lap TAPP (b/l)	prolene	YES	no
O18062229	I18030596	56/M	28-Sep-18	open (b/l)	prolene	no	no
O01028341	I18015860	56/M	28-May-18	open (Left)	prolene	YES	YES
O18020811	I18010366	57/F	06-Apr-18	open (Right)	prolene	no	no
O18045622	I18022729	57/M	23-Jul-18	Lap TAPP (b/l)	prolene	no	no
O18046455	I18022936	57/M	25-Jul-18	Lap TAPP (Left)	prolene	no	no
O18021946	I18011286	57/M	14-Apr-18	open (b/l)	prolene	no	no
O18079330	I18041164	57/M	20-Dec-18	open (b/l)	prolene	no	no
O18032633	I18016154	57/M	01-Jun-18	open (Left)	prolene	no	no
O18039994	I18020026	57/M	30-Jun-18	open (Left)	prolene	no	no
O14085447	I17054018	57/M	19-Dec-17	TAPP (b/l)	prolene	YES	no
O17094147	I17053637	57/M	16-Dec-17	TAPP (Right)	prolene	no	no
O17091222	I18023935	58/M	02-Aug-18	Lap TAPP (b/l)	prolene	no	no
O11078828	I18016059	58/M	25-May-18	Lap TAPP (Left)	prolene	YES	no
O18049200	I18028966	58/M	19-Sep-18	Lap TAPP (Left)	prolene	no	no
O14047737	I18005013	58/M	23-Feb-18	open (b/l)	prolene	no	no
O17089427	I18006900	58/M	08-Mar-18	open (b/l)	prolene	no	no
O11053763	I18007572	58/M	12-Mar-18	open (b/l)	prolene	no	no
O17091732	I17053949	58/M	23-Dec-17	open (Left)	prolene	no	no
O12016634	I18002341	58/M	27-Jan-18	open (Right)	prolene	no	no
O18008518	I18004449	58/M	22-Feb-18	open (Right)	prolene	no	no
O99005770	I18011936	58/M	21-Apr-18	open (Right)	prolene	no	no
O18016607	I18008851	58/M	20-Mar-18	TAPP (b/l)	prolene	no	no

O18032631	I18016153	59/M	26-May-18	open (Left)	prolene	no	no
O18016967	I18009916	59/M	30-Mar-18	TAPP (b/l)	prolene	no	no
O14068151	I18029982	60/M	24-Sep-18	open (b/l)	prolene	YES	no
O15081615	I19001009	60/M	14-Jan-19	open (b/l)	prolene	YES	no
O18065511	I18032188	60/M	13-Oct-18	open (Right)	prolene	no	no
O18022795	I18011349	60/M	12-Apr-18	TEP (right)	prolene	no	no
O13042306	I18031901	61/M	10-Oct-18	Lap TAPP (Right)	prolene	no	no
O18057121	I18040988	61/M	19-Dec-18	Lap TEP (b/l)	prolene	no	no
O07025785	I18023004	61/M	26-Jul-18	open (b/l)	prolene	no	no
O12078792	I18036301	61/M	16-Nov-18	open (b/l)	prolene	no	no
O12087897	I18004071	61/M	08-Feb-18	TAPP (Right)	prolene	no	no
O18023910	I18012616	62/M	27-Apr-18	open (b/l)	prolene	no	no
O16056803	I18033157	62/M	22-Oct-18	open (b/l)	prolene	no	no
O18043127	I18022928	62/M	26-Jul-18	open (Left)	prolene	no	no
O15041720	I18016118	62/M	30-May-18	open (Right)	prolene	no	no
O18022690	I18015104	63/M	17-May-18	Lap TAPP (b/l)	prolene	no	no
O07022577	I18013666	63/M	05-May-18	Lap TEP (b/l)	prolene	YES	YES
O18011234	I18016202	63/M	31-May-18	open (Left)	prolene	no	no
O08007764	I18014885	63/M	15-May-18	open (Right)	prolene	no	no
O18035422	I18017790	63/M	08-Jun-18	open (Right)	prolene	no	no
O10055070	I18032445	64/M	13-Oct-18	Lap TAPP (Right)	prolene	no	no
O18016676	I18009270	64/M	27-Mar-18	open (b/l)	prolene	no	no
O15025217	I18017618	64/M	06-Jun-18	open (b/l)	prolene	no	no
O18003227	I18001663	64/M	18-Jan-18	open (Left)	prolene	YES	no
O18031812	I18015673	64/M	25-May-18	open (Left)	prolene	no	no
O12007579	I18011436	64/M	13-Apr-18	TEP (b/l)	prolene	no	no
O18005853	I18004987	65/F	19-Feb-18	open (Left)	prolene	no	no
O15084714	I18018580	65/M	15-Jun-18	Lap TAPP (b/l)	prolene	no	no
O18026216	I18013018	65/M	05-May-18	open (b/l)	prolene	YES	YES
O18034973	I18017516	65/M	08-Jun-18	open (b/l)	prolene	YES	YES
O11041880	I18002055	65/M	24-Jan-18	open (Right)	prolene	no	no
O18032159	I18015925	65/M	30-May-18	open (Right)	prolene	no	no
O18048691	I18024182	65/M	03-Aug-18	open (Right)	prolene	YES	no
O18029241	I18036591	65/M	19-Nov-18	open (Right)	prolene	YES	YES
O18024035	I18012429	66/M	21-Apr-18	Lap TAPP (Right)	prolene	no	no
O11075645	I18017920	66/M	12-Jun-18	open (b/l)	prolene	no	no
O17093222	I17052392	66/M	09-Dec-17	open (Left)	prolene	no	no
O18031981	I18015801	66/M	26-May-18	open (Left)	prolene	no	no
O18011668	I18006346	66/M	02-Mar-18	TEP (right)	prolene	no	no

O18082976	I18040762	67/M	26-Dec-18	open (b/l)	prolene	YES	no
O18037170	I18019635	68/M	23-Jun-18	Lap TEP (b/l)	prolene	no	no
O18006359	I18004986	68/M	26-Feb-18	open (b/l)	prolene	no	no
O14027787	I18023303	68/M	26-Jul-18	open (Left)	prolene	no	no
O16006987	I18010495	68/M	04-Apr-18	TEP (Left)	prolene	no	no
O18010985	I18013343	69/M	02-May-18	open (Left)	prolene	YES	no
O18077123	I18039233	69/M	05-Dec-18	open (Right)	prolene	no	no
O00008050	I18003260	69/M	01-Feb-18	TEP (right)	prolene	YES	YES
O18071201	I18037406	70/M	20-Nov-18	Lap TEP (Right)	prolene	no	no
O18011241	I18005898	70/M	27-Feb-18	open (b/l)	prolene	no	no
O18022921	I18012098	70/M	21-Apr-18	open (Right)	prolene	no	no
O16036365	I18041131	71/M	20-Dec-18	Lap TAPP (Left)	prolene	no	no
O18028234	I18015602	72/M	29-May-18	open (Right)	prolene	no	no
O18021097	I18012109	72/M	19-Apr-18	TAPP (Right)	prolene	no	no
O18018207	I18010402	72/M	04-Apr-18	TEP (b/l)	prolene	no	no
O13075610	I18036639	73/M	16-Nov-18	open (b/l)	prolene	YES	YES
O12069262	I18005037	73/M	17-Feb-18	open (Left)	prolene	no	no
O17099022	I17055036	73/M	29-Dec-17	TEP (Left)	prolene	YES	no
O13032169	I18003168	74/F	01-Feb-18	open (Right)	prolene	no	no
O18046977	I18023215	75/M	26-Jul-18	open (b/l)	prolene	no	no
O18030980	I18017203	77/M	02-Jun-18	open (Left)	prolene	no	no
O15028429	I18023955	78/M	30-Jul-18	open (Left)	prolene	no	no
O01026714	I18023476	79/M	31-Jul-18	open (b/l)	prolene	no	no
O18069694	I18036983	80/M	21-Nov-18	open (b/l)	prolene	no	no
O11041776	I18024157	80/M	02-Aug-18	open (Right)	prolene	YES	no
O18058073	I18028548	82/M	20-Sep-18	Lap TAPP (b/l)	prolene	no	no
O18015988	I18008067	82/M	16-Mar-18	open (b/l)	prolene	no	no