

# Open "Tension-Free" Repair of Inguinal Hernias: The Lichtenstein Technique

Parviz K. Amid,<sup>1</sup> Alex. G. Shulman<sup>2</sup> and Irving L. Lichtenstein<sup>2</sup>

From the Lichtenstein Hernia Institute, Los Angeles, California, <sup>1</sup>Harbor-UCLA Research and Education Institute Departments of Surgery at Harbor-UCLA and Cedars-Sinai Medical Centers, Los Angeles, California and <sup>2</sup> Cedars-Sinai Medical Center, Los Angeles, California, USA

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## ABSTRACT

**Objective:** To report our results with an open, tension free technique of repairing primary inguinal hernias using polypropylene (Marlex) mesh under local anaesthesia.

**Design:** Open study.

**Setting:** Specialist clinic, USA.

**Subjects:** 3480 Out of a total of 4000 men whose primary inguinal hernias were repaired between June 1984 and June 1995.

**Interventions:** Hernia repair involving total reinforcement of the transversalis fascia with mesh.

**Main outcome measure:** Morbidity, particularly recurrence.

**Results:** A total of 1776 (44.4%) were direct hernias, 1724 (43.2%) indirect, and 500 (12.5%) a combination; 456 (11.4%) were sliding hernias. Patients were followed up for a mean of 5½ years (range 1-11) and 520 were lost to follow-up, leaving 3480 (87.0%) for analysis. All patients followed up were examined by a physician. There were five recurrences (0.1%), four at the pubic tubercle and one in which the mesh had torn away from the inguinal ligament because it was too narrow. There has been one recurrence in the last six years of the study. One patient developed orchitis. There was one case of postoperative neuralgia. There were no seromas that required aspiration. Most patients had returned to work within two weeks, including the manual workers.

**Conclusion:** Repair of primary inguinal hernias under local anaesthesia with the open, tension-free technique using polypropylene mesh results in acceptable morbidity, and appreciable reductions in postoperative discomfort, duration of hospital stay, recurrence rate and costs.

**Key words:** inguinal hernia, tension-free repair, mesh repair, biomaterials, outpatient hernia surgery.

## INTRODUCTION

There is morphological and biochemical evidence that inguinal hernias in adult men are associated with a metabolic disorder of collagen in the fibroconnective tissue of the groin (2, 10, 24, 26, 35). Reduced hydroxyproline concentration and, therefore, collagen in the aponeurotic tissue of the groin with its attenuation extending several centimetres beyond the hernial defect has been described, and a reduced hydroxyproline:proline ratio suggests that hydroxylation of proline is impaired. These changes lead to weakening of the transversalis fascia and development of hernias. To use this already defective tissue, particularly under tension, is counterproductive (25), and total reinforcement with a sheet of mesh securely fixed beyond the boundary of Hesselbach's triangle is a more effective procedure (19).

## PATIENTS AND METHODS

Between June 1984 and June 1995, 4000 patients with primary inguinal hernias have been operated on. The series included 1000 bilateral inguinal hernias that were repaired simultaneously under local anaesthesia (5). All patients were male from 20-88 years of age (median age 52). A total of 1776 (44.4%) had indirect hernias, 1724 (43.1%) had direct, and 500 (12.5%) had a combination of indirect and direct; 456 (11.4%) had sliding hernias; 3140 (78.5%) were of normal weight or were up to 9 kg overweight, 788 (19.7%) were 9-23 kg overweight, and 80 (2%) were more than 23 kg overweight.

The procedure was done under local anaesthesia, which is our preferred choice for all reducible adult inguinal hernias. It is safe, simple, effective, econom-

ical, and without side effects, and gives good postoperative analgesia.

Local anaesthesia should be given correctly with gentle manipulation of the anaesthetised tissues. Our choice of anaesthetic is a 50/50 mixture of 1% lignocaine (Xylocaine) and 0.5% bupivacaine (Marcaine). The therapeutic maximum dose of lignocaine is 300 mg in plain form, and 500 mg with adrenaline. For bupivacaine, the dose is 175 mg plain, and 225 mg with adrenaline.

### *Techniques of anaesthesia*

An average of 45 ml of this mixture is usually sufficient for a unilateral hernia repair.

**Subdermal infiltration.** About 5 ml of the mixture is infiltrated along the line of the incision with a 2 inch long 25 gauge needle inserted into the subdermal tissue parallel with the surface of the skin. Infiltration continues as the needle is advanced. Movement of the needle reduces the likelihood of intravascular infusion of the drugs because even if the needle penetrates a blood vessel, the tip will not remain in the vessel long enough to deliver a substantial amount of the anaesthetic agent intravenously. This step blocks the subdermal nerve endings and reduces the discomfort of the intradermal infiltration which is the most uncomfortable stage of local anaesthesia.

**Intradermal injection.** The needle in the subdermal plane is withdrawn slowly until the tip of the needle reaches the intradermal level. Without extracting the needle completely, the dermis is infiltrated by slow injection of about 3 ml of the mixture along the line of the incision. Addition of sodium bicarbonate solution to increase the pH of the mixture and reduce the burning pain of intradermal infiltration has been suggested (36).

**Deep subcutaneous injection.** A total of 10 ml of the mixture is injected deep into the subcutaneous adipose tissue through vertical insertions of the needle (perpendicular to the skin surface) 2 cm apart. Again, injections are continued as the needle is kept moving to reduce the risk of intravascular infusion.

**Subaponeurotic injection.** About 8–10 ml of the anaesthetic mixture is then injected immediately underneath the aponeurosis of the external oblique muscle through a window created in the subcutaneous fat at the lateral corner of the incision. This injection floods the enclosed inguinal canal and anaesthetises all three major nerves in the region.

It also separates the external oblique aponeurosis from the underlying ilioinguinal nerve, reducing the likelihood of injuring the nerve when the external oblique aponeurosis is incised.

Occasionally it is necessary to infiltrate a few ml of

the mixture at the level of the pubic tubercle, around the neck and inside the indirect hernia sac, to achieve complete local anaesthesia.

The local anaesthesia can be further prolonged by splashing 10 ml of the mixture (with added adrenaline) into the inguinal canal before closure of the external oblique aponeurosis and in the subcutaneous space before skin closure (8).

Epidural anaesthesia may be preferred for repair of bilateral inguinal hernias in obese patients. Sedative drugs given by the surgeon (or preferably by an anaesthetist as "monitored anaesthesia care" in the form of infusion of rapid short-acting, amnesic and anxiolytic agents such as propofol), reduce the patient's anxiety. This also reduces the amount of local anaesthetic agents required, particularly for bilateral inguinal hernia repair.

### *Technique of operation*

After skin incision, which starts from the pubic tubercle and extends laterally for 5 cm, the external oblique aponeurosis is opened in the direction of its fibres and the lower leaf freed from the spermatic cord, which with its cremaster covering is freed from the floor of the inguinal canal and the pubic bone for a distance of about 2 cm beyond the pubic tubercle. The anatomical plane between the cremasteric sheath and the aponeurotic tissue attached to the pubic bone is avascular, so there is no risk of damaging the testicular blood flow. When lifting the cord, care should be taken to include the external spermatic vessels and the genital nerve with the cord. This assures that the genital nerve, which is always in juxtaposition to the external spermatic vessels, is preserved (Fig. 1). Cutting or ligating the genital nerve can cause long

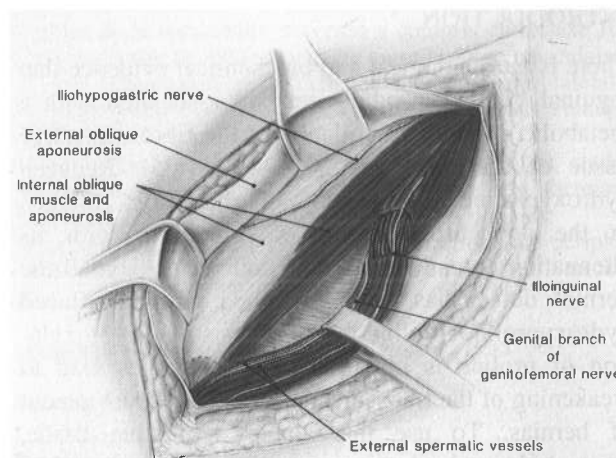


Fig. 1. Spermatic cord together with its cremasteric covering, external spermatic vessels, and genital nerve is raised and the cremasteric fibres are cut transversely at the level of the internal ring.

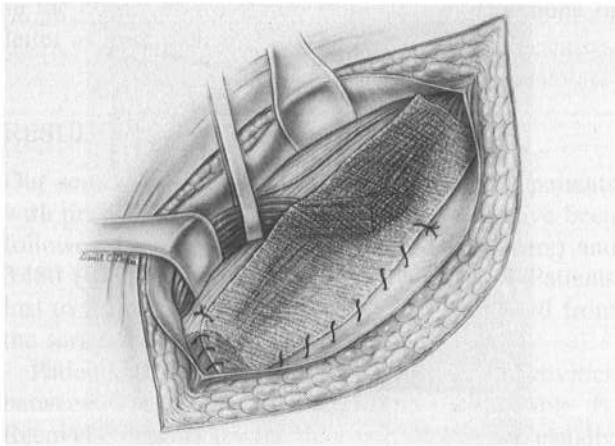


Fig. 2. Medial end of the patch overlaps the pubic bone by 1.5 to 2 cm.

term incapacitating neuralgia (18). The ilioinguinal and iliohypogastric nerves should also be preserved.

To thin the spermatic cord, the spermatic fat pad (lipoma of the cord) should be excised. The cremasteric fibres are transversely or longitudinally incised at the level of the internal ring over a clamp to avoid the nerves (Fig. 1). The latter prevents disturbance of the retractibility of the testis. Complete stripping and excision of the cremasteric fibres is unnecessary (21), and can result in injury to the nerves, small blood vessels, and kinking of the vas deferens. It therefore increases the likelihood of postoperative neuralgia (15), ischaemic orchitis, and defective ejaculation (9).

Indirect hernial sacs are freed from the cord to a point beyond the neck of the sac. Opening the sac allows for digital examination of the femoral ring and the sac is then inverted into the abdomen without ligation [which would cause more postoperative pain (28, 32)]. To minimise the risk of postoperative

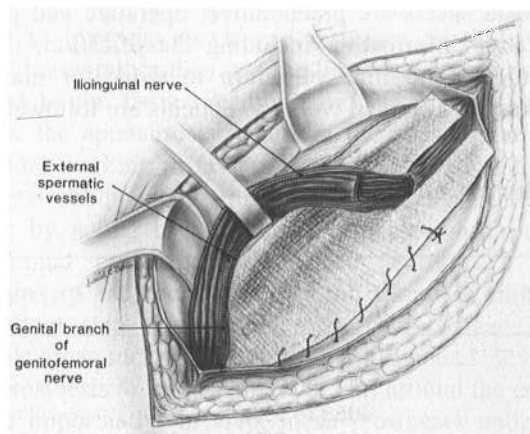


Fig. 3. Spermatic cord is placed in between the two tails of the mesh.

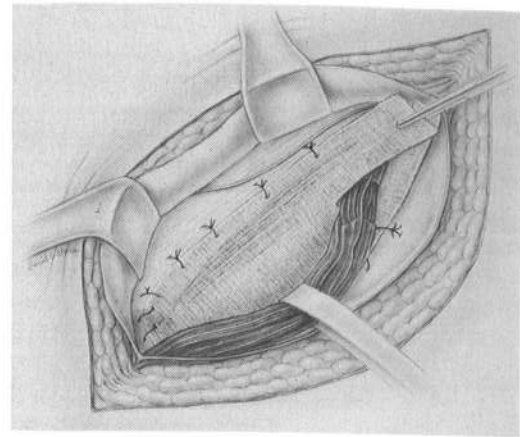


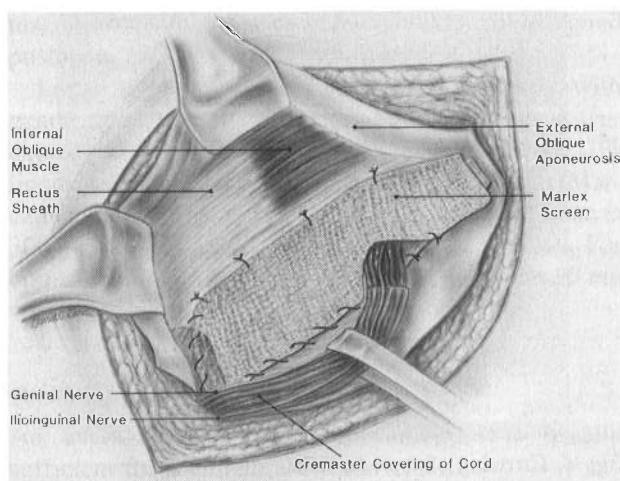
Fig. 4. Crossing of the two tails.

ischaemic orchitis as a result of extensive dissection, complete scrotal hernia sacs are transected at the midpoint of the canal, leaving the distal section in place. The anterior wall of the distal sac is incised to prevent postoperative formation of a hydrocele (37).

If the hernia is direct, the femoral ring is evaluated through a small opening in the floor of the inguinal canal. If it is large, the direct sac is inverted with an absorbable suture. The external oblique aponeurosis is separated from the underlying internal oblique muscle high enough to accommodate a 6–8 cm wide polypropylene (Marlex) patch that can overlap the internal oblique muscle and aponeurosis by at least 2–3 cm above the upper border of Hesselbach's triangle. A precut sheet of 8 × 16 cm of mesh is used, and if necessary it can be trimmed for 1–2 cm to match the varying sizes of the inguinal floor. We prefer Marlex because its texture promotes fibroplasia and its monofilament structure does not promote or harbour infection (4). The medial end of the mesh is rounded to the shape of the medial corner of the inguinal canal. With the cord retracted upwards, the rounded corner is sutured with a running suture of a non-absorbable monofilament to the aponeurotic tissue over the pubic bone and overlapping the bone by 1.5–2 cm (Fig. 2). This is a crucial step in the repair because failure to overlap this bone may result in recurrence. The periosteum of the bone is avoided.

This suture should be continued to attach the lower edge of the patch to the shelving margin of Poupart's ligament up to a point just lateral to the internal ring. If there is a concurrent femoral hernia, the mesh is also sutured to Cooper's ligament 1–2 cm below its suture line with the inguinal ligament to close the femoral ring.

A slit is made at the lateral end of the mesh creating two tails, a wide one (two-thirds) above and a narrower (third) below.

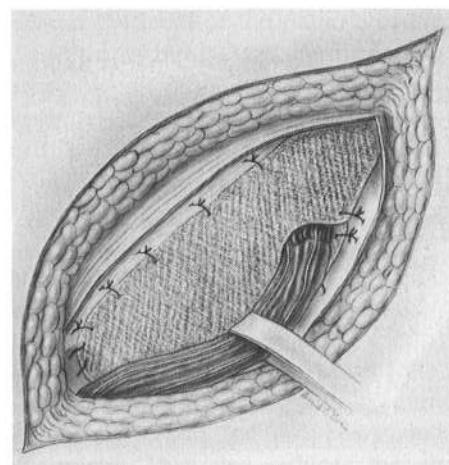


**Fig. 5.** The lower edges of the two tails are sutured to the shelving margin for creation of a new internal ring made of mesh.

The upper wide tail is grasped with a haemostat and passed towards the head of the patient from underneath the spermatic cord; this positions the cord between the two tails of the mesh (Fig. 3).

The wider upper tail is placed over the narrower one and held with a haemostat (Fig. 4). With the cord retracted downwards and the upper leaf of the external oblique aponeurosis retracted upwards, the upper edge of the patch is sutured to the internal oblique aponeurosis or muscle, whichever is available, with a few interrupted absorbable sutures avoiding injury to or entrapment of the iliohypogastric nerve. Sharp retraction of the upper leaf of the external oblique during this phase of the repair is important because it achieves the appropriate amount of laxity for the patch. When the retraction is released, the mesh buckles slightly, and this laxity assures a true tension-free repair and is taken up when the patient strains on command during the operation or resumes an upright position.

Using a single non-absorbable monofilament suture, the lower edges of each of the two tails are fixed to the



**Fig. 6.** The lateral ends of the tails are tucked underneath the external oblique aponeurosis.

shelving margin of Poupart's ligament just lateral to the completion knot of the lower running suture.

This creates a new internal ring made of mesh (Fig. 5). The crossing of the two tails produces a configuration similar to that of the normal transversalis fascia sling, which is assumed to be largely responsible for the normal integrity of the internal ring.

The excess patch on the lateral side is trimmed, leaving about 4–5 cm of mesh beyond the internal ring. This is tucked underneath the external oblique aponeurosis (Fig. 6), which is then closed over the cord with an absorbable suture.

Patients are discharged within a few hours of their operation with minimal discomfort, and pain is controlled by 2–20 tablets of 5 mg hydrocodone bitartrate. Unrestricted activity is encouraged.

#### *Follow-up*

A computerised follow-up system is used. Recorded in the data sheets are preoperative, operative and post-operative information including classification, complications, and time of return to work for manual workers and clerical workers. Patients are followed up

**Table I.** Length of time taken to return to normal activities after hernia repair

Total no of patients: 4000.

Time after operation (days)	Manual workers (n = 1600)	Clerical workers (n = 2400)
Less than 7 days	173 (10.8%)	1085 (45.2%)
7 days	654 (40.9%)	737 (30.7%)
10 days	333 (20.8%)	406 (16.9%)
14 days	282 (17.6%)	113 (4.7%)
More than 14 days	158 (9.9%)	59 (2.5%)

in the clinic, as we regard follow up by telephone or letter as unreliable (1, 23).

## RESULTS

Our series comprises 4000 consecutive male patients with primary inguinal hernias. The patients have been followed from 1 to 11 years (mean of  $5\frac{1}{2}$  years) and 3480 (87%) have been examined regularly. Patients lost to follow-up ( $n = 520$ , 13%) were excluded from the series.

Patients usually return to their unrestricted activities between 2 and 14 days after operation (Table I). Recovery periods longer than two weeks are usually the consequence of coexisting medical problems. There was only one major complication, a case of orchitis. There was one chronic postoperative neuralgia and no patient developed a seroma that required aspiration. Patients who were operated on early in the evolution of this technique developed recurrences as a result of technical errors. Three hernias recurred at the pubic tubercle because of failure to overlap the bone with the mesh. One recurrence resulted from total disruption of the mesh from the inguinal ligament because the mesh was too narrow. All four recurrences were repaired by the Lichtenstein "plug" technique for the repair of femoral and recurrent inguinal hernias (3, 29). There has been only one recurrence in those patients operated on within the last six years. Similar results have been achieved and reported by other authors (7, 12, 13, 16, 17, 20, 22, 27, 33).

## DISCUSSION

The use of a wide piece of mesh to overlap with tissues beyond the boundary of Hesselbach's triangle for 2–4 cm is important to reduce the chance of recurrence. After incorporation is complete, this overlap results in uniform distribution of intra-abdominal pressure over the much wider surface of the overlapped area rather than just the line where the mesh is joined to the tissue. Additionally, placing the mesh below the aponeurosis results in the intra-abdominal pressure working in favour of the repair, because the external oblique aponeurosis keeps the mesh tightly in place by acting as an external support when intra-abdominal pressure rises. Proper fixation of the margins of the mesh to the groin tissue is another important step in the prevention of recurrence. In mobile areas such as the groins, there is a tendency for the prosthesis to fold, wrinkle, or curl around the cord. More importantly, in vivo, mesh prostheses undergo 10–20% shrinkage. Due to the above factors, the slightest movement of the mesh from the pubic

tubercle, the inguinal ligament, and the area of the internal ring is a leading cause of failure of mesh repair of inguinal hernias.

Use of the tension-free technique in conjunction with local anesthesia has had an important impact on hospital stay, postoperative discomfort, recovery period, recurrence rate and the cost of hernia surgery.

Local anaesthesia given before the incision is made produces longer postoperative analgesia because local infiltration theoretically inhibits build-up of local nociceptive molecules and therefore gives better pain control. Experimental studies have shown that peripheral tissue injury may result in long lasting changes in central processing, with reduction in threshold, amplification of responses, expanded receptive fields and after discharges of dorsal horn neurons. Subsequently, it has been suggested that surgical injury in humans may lead to comparable alterations, resulting in amplification and prolongation of postoperative pain (14, 38, 39). Preoperative local anaesthesia in conjunction with general or spinal anaesthesia reduces postoperative pain and wound tenderness compared with patients operated under general or spinal anaesthesia only (11, 34).

Lignocaine provides rapid onset and bupivacaine results in a longer duration of local anesthesia. Reduction in onset time has been reported with the addition of sodium bicarbonate 100 mmol/L of lignocaine (16). Anaesthetic duration time can be further prolonged by addition of adrenaline to the mixture. Adrenaline, however, may produce severe prolonged hypertension in patients receiving monamine oxidase inhibitors or tricyclic antidepressants.

A multicentre study (30) of five groups (7, 12, 19, 20, 33) of surgeons with a special interest in hernia surgery showed recurrence rates of 0–0.7% (including recurrences during the learning curve), a rejection rate of zero, and an infection rate of less than 0.5%.

A survey of 70 surgeons with no special interest in hernia surgery who had done 22300 Lichtenstein open "tension-free" hernioplasties gave similar results with regard to postoperative recurrence, rejection, and infection rates, as well as post-operative recovery period (5, 31).

The fact that the results from surgeons with no special interest or expertise in hernia repair are identical to those with a special interest in this subject is a testimony to the simplicity, safety, and effectiveness of the open "tension-free" hernioplasty. The procedure is simple and safe and achieves all the goals of modern surgery, such as more comfortable post-operative course and rapid return to unrestricted activities, with a recurrence rate of virtually zero (0.1% from early operations). It also avoids the need

for general anaesthesia and invasion of the peritoneal or preperitoneal spaces and their associated potential complications.

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## RÉSUMÉ

**But:** Rapporter nos résultats après cure de première intention de hernie inguinale sans tension par mise en place par voie inguinale sous anesthésie locale d'une plaque de polypropylène (Marlex).

**Type d'étude:** Ouverte.

**Provenance:** Clinique spécialisée, USA.

**Patients:** Deux mille huit cent vingt huit patients sur un total de 3250, opérés d'une hernie inguinale de première intention entre Juin 1984 et Juin 1995.

**Méthodes:** Cure de hernie avec mise en place d'une plaque pour renforcer le fascia transversalis.

**Principaux critères de jugement:** La morbidité et notamment les récurrences.

**Résultats:** Il y avait 1443 (44,4%) hernies directes, 1401 (43,1%) hernies indirectes, et 406 (12,5%) hernies mixtes; 371 hernies (11,4%) étaient des hernies par glissement. Les patients ont été suivis en moyenne pendant 4 ans et 1/2 (extrêmes 1-9) et il y a eu 422 perdus de vue, faisant ainsi porter l'étude sur 2828 (87%) patients. Tous les patients suivis ont été examinés par un médecin. Il y a eu 4 récurrences (0,1%), dont trois pour lesquelles la plaque n'avait pas été placée correctement de telle sorte qu'elle recouvre l'épine du pubis, et une pour laquelle la plaque s'était plicaturée,

restant à distance du ligament inguinale car elle était trop étroite. Il n'y a eu aucune récurrence chez les patients opérés au cours des trois dernières années de l'étude. Un patient a eu une orchite. Il n'y a pas eu de névralgie postopératoire et aucun épanchement lymphatique nécessitant une ponction. La reprise du travail a pu se faire dans les 15 jours postopératoires pour la plupart des patients y compris les travailleurs de force.

**Conclusions:** La cure de première intention des hernies inguinales sans tension par mise en place par voie inguinale sous anesthésie locale d'une plaque de polypropylène s'accompagne d'une morbidité acceptable, et d'une réduction appréciable de la gêne postopératoire, de la durée d'hospitalisation, et du coût.

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*Address for correspondence:*

Parviz K. Amid, M.D.  
Lichtenstein Hernia Institute  
9201 Sunset BLVD  
Suite 505  
Los Angeles, CA 90069  
USA