A modified technique of lichtenstein repair using fibro-cremasteric sheath to cover the mesh versus traditional Lichtenstein hernioplasty: a comparative study

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Introduction The Lichtenstein hernioplasty is the most widely used repair for inguinal hernia, with recurrence rate of 1–2%. Incidence of chronic postsurgery pain ranges from 10 to 50%. Pain may be due to peripheral neuropathy in the ilioinguinal and iliohypogastric nerves, which are entrapped in inguinal canal in contact with mesh, which produces a massive fibrotic reaction. In this study, a modification in Lichtenstein repair was suggested, in which the mesh was covered by a layer derived from cremasteric sheath of the cord to avoid contact of the cord and nerves of the canal with the mesh thus reducing their affection by massive fibrotic reaction. A comparative study between this modified technique and traditional Lichtenstein repair was done.

Aim To evaluate the results of the modified technique versus traditional method of Lichtenstein repair especially on postoperative pain and other postoperative complications.

Patients and methods A total of 90 patients are classified into two groups: group A (45 patients) was operated by modified technique and group B (45 patients) was operated by traditional technique. Operative time, hospital stay, return to normal activities, and early and late complications, particularly pain, were assessed, and data were collected for statistical analysis in a follow-up period of 18 months.

Results No intraoperative complications or recurrences were reported in both groups. The operative time in the new technique was 58.4±9.2 min compared with 51.3±10.6 min in the traditional method, which is significantly shorter. The mean hospital stay was 1±0.4 days in the modified technique group and 1.2±0.6 in the traditional group. Hospital stay and complications other than postoperative pain were similar in both groups and had no significance. Early postoperative pain showed minimal nonsignificant difference as mean visual analogue scale was slightly lower in patients of the modified method (3.9) than in the traditional group (4.1). A total of 17 (37.7%) patients in group A and 15 (33.3%) patients in group B required no medication, whereas others were administered nonsteroidal analgesics. Patients who needed analgesics in the first week postoperatively were 10 (22%) in group A and 12 (26.6%) in group B. In the second and third weeks, none of patients in group A and three (6.5%) patients in group B needed pain medication. At 6-month follow-up, it was reported that the rate of pain-related impairment of function was 11% (five cases) after modified method and 17.7% (eight cases) after Lichtenstein repair. Pain-related impairment of function at 1-year follow-up occurred in three (6.5%) patients of group A and six (13.3%) patients in group B. At 18 months, two (4.4%) patients in group A and five (11%) patients in group B had pain and discomfort at the inguinal region. There were statistically significant differences in chronic pain between both groups at 6, 12, and 18 months.

Conclusion The results showed that suggested modification may be better or at least comparable to traditional Lichtenstein procedure in reduction of chronic postoperative pain with no increase in complication rates. However, larger studies with long-term follow-up are needed to assess this technique.

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Background

Inguinal hernia is a common disease that affects millions of people worldwide annually. Inguinal hernias account for 75% of abdominal wall hernias, with a lifetime risk of 27% in men and 3% in women [1]. Since the era of prosthetic meshes started in surgical treatment of inguinal hernia, dramatic reduction in recurrence rates to an acceptable level was recorded [2–4].

The Lichtenstein technique of hernioplasty is the most widely used (with various modifications) procedure in open inguinal hernia because it is a tension-free repair with high effectiveness and safety, rapid recovery, early return to usual activities, good long-term result, and very low recurrence rate of 1–2% [2–5].

On the contrary, chronic postsurgery pain has become one of the most important complications of mesh hernioplasty. Pain recorded in reviews has marked variations; it had a rate of 10–12% of patients in most of the studies, whereas other studies showed ranges of 37% [5,6]. Presence of chronic

postoperative pain reached up to 50% of cases in some literatures, even up to a year after surgery [6,7]. Chronic postoperative pain after Lichtenstein procedure is a frequent complication with an incidence rate of 12–40%. Many theories to explain the causes for pain after Liechtenstein inguinal hernia repair had been suggested; one of them is peripheral neuropathic changes in the ilioinguinal and iliohypogastric nerves owing to their entrapment in the sub-fascial space in direct contact with the mesh which produces a massive foreign body fibrotic reaction that involves the cord contents and muscular and nervous structures in the canal [8,9].

As one of the aims of inguinal hernia operation is to minimize chronic postoperative pain, the ideal surgical technique is still debated because of chronic complications such as pain and impaired sexual activity. Many technical modifications were proposed in the past to improve postoperative results and minimize chronic neuralgia that causes patients' discomfort [1,8–10].

The objective of the study is to assess the outcome after inguinal hernioplasty using the traditional method of Lichtenstein repair compared with a modified technique of Lichtenstein procedure. The procedure described in this study is applicable to all cases of primary inguinal hernia. It employs the principle of covering the mesh, after its fixation as usual, with a layer from the cremasteric muscle and fascia to isolate the mesh and prevent its contact with the canal contents, specially the nerves. The procedure aims to reduce the incidence of chronic neuralgia that produces chronic pain, discomfort, and sometimes acute disabling pain.

Aim

The aim is to evaluate results of the modified technique versus traditional method of Lichtenstein repair especially on postoperative pain and other postoperative complications.

Patients and methods

Between October 2016 and January 2019, 90 patients had been selected to enter the study from the patients coming to the outpatient surgery clinic in Al-Hussien University Hospital with primary inguinal hernia, and decision of surgical repair (inguinal hernioplasty) was taken for them. The patients were examined and investigated for diagnosis and preoperative preparation. A written informed consent was taken from all participants after proper explanation of the study.

Inclusion criteria

The following were the inclusion criteria:

(1) Male patients more than 18 years of age.
(2) Elective noncomplicated cases of inguinal hernia, including direct and indirect hernia that requires surgical intervention.
(3) Eligible for procedure performed under general or spinal anesthesia.

Exclusion criteria

The following were the exclusion criteria:

(1) Incarcerated or irreducible hernia.
(2) Other abdominal hernias being operated at the same time
(3) If other hernia or abdominal surgery was planned for surgery in the follow-up period.
(4) Emergency procedures.
(5) Previous surgery that impaired the sensation in the groin area.
(6) Local or systemic infection.
(7) BMI more than 40 kg/m^2 or BMI less than 20 kg/m^2.
(8) Known disease that impairs central or peripheral nerve function.
(9) Concurrent malignant disease.
(10) Impairment of cognitive function (e.g. dementia) and mental disorder.
(11) Chronic pain that requires daily medication owing to other reasons.

The 90 patients had been randomly categorized into two groups: group A (45 patients) for hernioplasty by the modified Lichtenstein technique with mesh covering by a layer of cremasteric muscle and fascia and group B (45 patients) for traditional Lichtenstein repair. Patients were categorized blindly, and every patient did not know which group he was included in.

Surgical technique

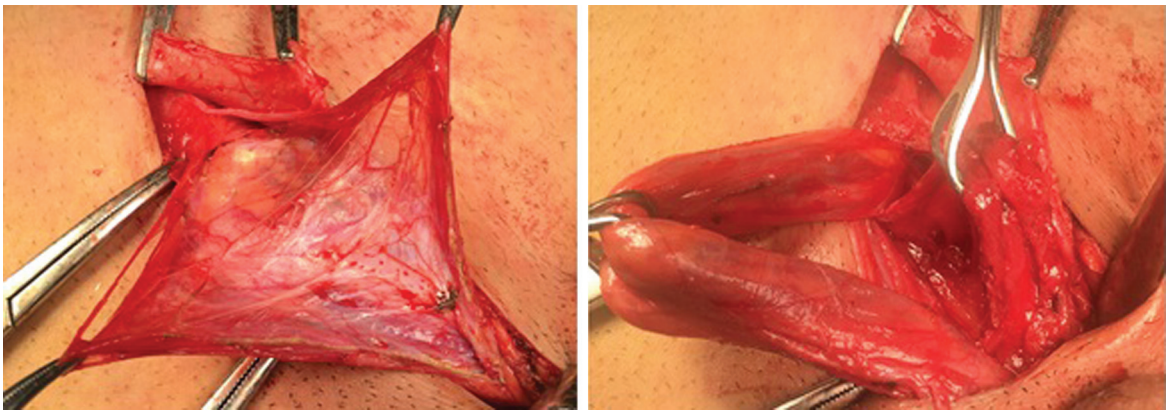
The idea of this modified technique depends on creating a layer from the cremasteric muscle and fascia covering the spermatic cord and using this layer to cover the polypropylene mesh to prevent direct contact between the mesh and nerves present in the inguinal canal. An oblique inguinal incision was made. The external oblique muscle was opened and the spermatic cord identified. The technique does not need the dissection of nerves lying in the inguinal canal

beneath the aponeurosis. The ilioinguinal nerve is adherent to cremaster in lateral part and the iliohypogastric nerve lies medially on the internal oblique. A longitudinal incision of the cremasteric sheath covering of the cord (formed of the cremasteric muscle and the external-spermatic fascia) was made in medial aspect. The margins of the incision were grasped by forceps and dissected from the cord elements. The opened cremasteric sheath (from the medial aspect of the inguinal canal) is exposed as the mesh will be covered by this anatomic layer. The spermatic cord was mobilized upward to allow dissection of the posterior portion of the cremasteric fascia located on the fascia transversalis with protection of the neurovascular structures in this area: the external spermatic vessels and the genital branch of the genito-femoral nerve (Fig. 1).

Then the hernia sac was identified, dissected from the cord elements, and excised or returned back into the abdominal cavity. According to the type and size of hernia, the transversalis fascia was plicated, particularly in direct hernia, to strengthen it without tension in some cases in both groups. In large inguino-scrotal hernias, when internal orifice is so wide, the width of the ring is reduced by a few stitches. Then the mesh was prepared as usual in Lichtenstein repair and placed on the floor of inguinal canal on top of the transversalis fascia covering the deep inguinal orifice and allowing passage of the cord content through split made in its lateral part. The mesh, extending laterally to the inguinal ligament and medially overlapping conjoint tendon, was fixed by nonabsorbable interrupted sutures. The tip of the mesh was extended to the pubic tubercle and was sutured in place by prolene 2/0 stitches (Fig. 2).

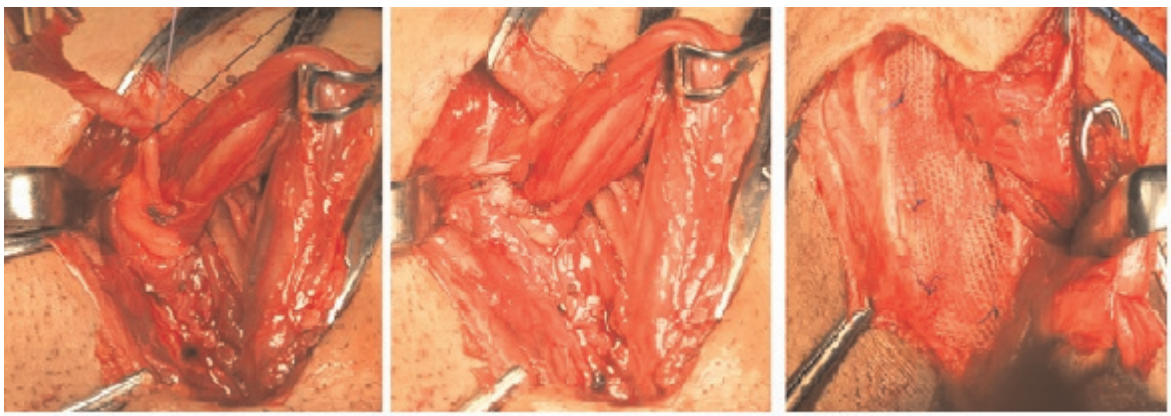
The medial margin of the fibro-cremasteric sheath was then dissected and transposed beneath the spermatic cord and fixed to cover the mesh, by means of

Figure 1



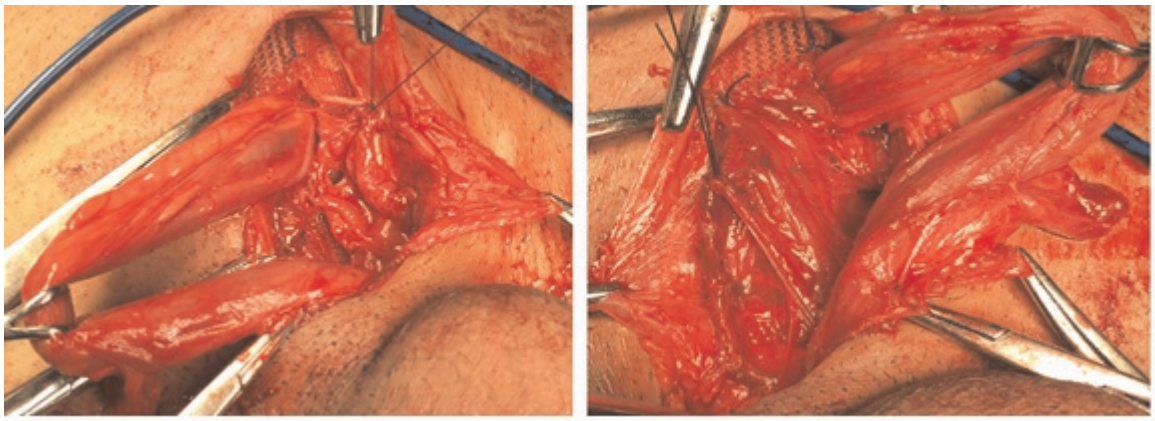
Opening of cremasteric fascial covering of the cord (on the left side) and after all around dissection from the cord to form a separate layer (on the right side).

Figure 2



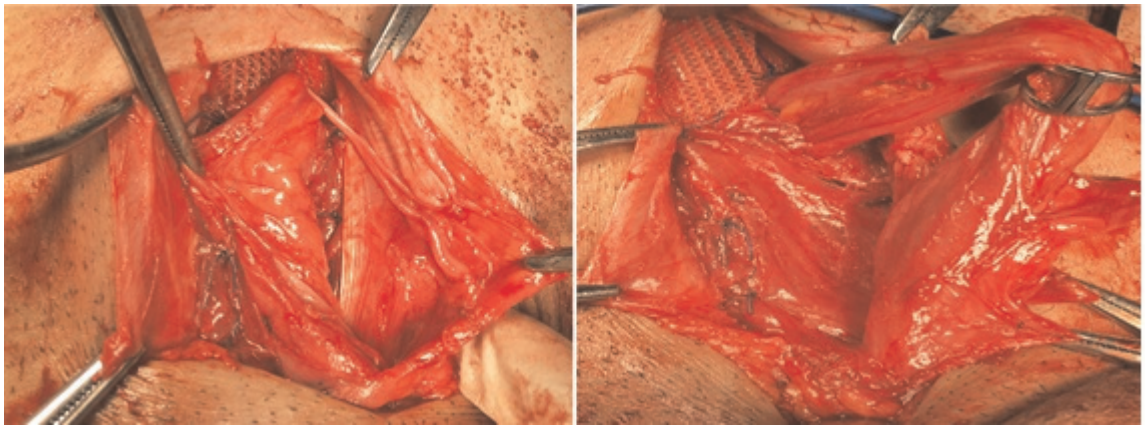
Dissection and excision of the sac from the cord (on the left side), plication of transversalis fascia, done only if weak posterior wall or large direct hernia (in the middle) and after fixation of mesh (on the right side).

Figure 3



Fixation of the fibro-cremasteric layer over the mesh laterally to the inguinal ligament (on the left side) and medially to the conjoint tendon (on the right side).

Figure 4



After fixation of covering layer, the ilioinguinal nerve is not in contact with mesh laterally (on the left side) and the ilio-hypogastric nerve is not in contact with mesh medially (on the right side).

nonabsorbable vicryl 2/0. The cremasteric layer in this way avoids adhesion between mesh and spermatic cord and nerves (Figs 3 and 4). Finally, the spermatic cord was returned to its usual position and the aponeurosis of the external oblique muscle is sutured with absorbable material.

In other group, traditional Lichtenstein repair was done according to European Hernia Society guidelines for treatment of inguinal hernia in adult patient [2,11,12].

Operative time (cut-to-suture time) and intraoperative complications were assessed. Postoperative pain and other complications were observed in the ward after surgery. Pain in the ward was treated using intramuscular nonsteroidal analgesics. Patients were discharged after they were fully mobilized, started oral feeding, open bowel, not in urine retention, and did not need any parenteral medications including analgesics. In the study, postoperative pain was recorded with a visual analogue scale (VAS) from 0 (no pain) to 10 (worst imaginable pain) on the postoperative day (POD 0) and the following days (POD 1 and POD 2) if the patient was not discharged. After discharge, the patient's pain and/or discomfort in terms of limitation of usual activities, and return to work were observed are reported. Presence of early local complications such as wound infection, seroma, hematoma, orchitis, and/or testicular edema was also recorded.

Follow-up

Follow-up visits were scheduled at 1, 2, and 3 weeks after surgery and then at 1, 3, 6, 12, and 18 months postoperatively to assess local signs such as chronic postoperative pain and/or discomfort, foreign body sensation, and hernia recurrence. A designed

questionnaire was used to get data about pain incidence, type, and intensity; medications needed in type and quantity; and effect on daily activities. Other complications are detected by questionnaire together with clinical examination (if needed according to patient complains) in the follow-up visits.

Statistical analysis

Collected data had been analyzed by special statistical programs for parametric and nonparametric statistics depending on the data distribution. If *P* value was up to 0.05, the result was considered significant. χ^2-Test was used to compare results of both groups. Moreover, a confidence interval had been calculated for the difference between the two groups. The mean, median, and SD of factors of the two groups had been calculated by the *t*-test.

Results

The results in this study were both surgeon and patient centered and were assessed using clinical assessment and patient questionnaires, including activity assessment scale, pain-related impairment of function (PIF), VAS, and inguinal pain questionnaire.

The end points for comparison between modified and traditional methods in this study were early postoperative pain measured by VAS, late pain (>14 days after surgery) with substantial pain-related impairment of function at the follow-up period, type and severity, cut-to-suture estimated operative time, postoperative hospital stay, time to return to normal daily activities, recurrence, and other complications related to the procedure (urinary retention, hematoma, seroma, ischemic orchitis, and infection).

A total of 90 patients were involved in the study, with a mean age of 35.63 years. Each group included 45 patients. The modified technique group had a mean age of 39.8 years whereas the traditional repair group had a mean age of 42.3 years. The *P* value for standard deviation was 0.529; so, there was no significant difference in the age between the two groups as shown in Table 1.

The operative time in modified technique group ranged between 54 and 81 min, with a mean of 58.4 ±9.2 min, and in the Lichtenstein group ranged between 49 and 72 min, with a mean of 51.3 ±10.6 min ($P<0.001$). Therefore, difference between the two groups was considered significant, as shown in Table 2.

Table 1 Comparison between the two studied groups regarding age

Age	Group A	Group B	*P* value
Range (years)	18.5–68.0	22.0–67.4	0.529
Mean	39.8	42.3	
SD	11.14	7.66	

Group A: patients with modified Lichtenstein technique. Group B: patients with traditional Lichtenstein repair.

Table 2 Comparison between operative times in the two groups

Operative time	Group A	Group B	*P* value
Range	54–81	49–72	<0.001
Mean	58.4	51.3	
SD	9.2	10.6	

Group A: patients with modified Lichtenstein technique. Group B: patients with traditional Lichtenstein repair.

Table 3 Hospital stay in both groups

Hospital stay	Group A	Group B	*P* value
Range	1–2	1–1.6	0.51
Mean	1	1.2	
SD	0.4	0.6	

Group A: patients with modified Lichtenstein technique. Group B: patients with traditional Lichtenstein repair.

Table 4 Return to work in both groups

Return to work	Group A	Group B	*P* value
Range	7–15	8–18	0.09
Mean	9.1	10.2	
SD	3.4	4.6	

Group A: patients with modified Lichtenstein technique. Group B: patients with traditional Lichtenstein repair.

The mean hospital stay in group A was 1±0.4 days and in group B was 1.2±0.6, and the *P* value was 0.51, as shown in Table 3. Return to work and daily activities in both groups showed that patients returned to work with a range of 7–15 days with a mean of 9.1±3.4 in group A and returned to work with a range of 8–18 days with a mean of 10.2±4.6 in group B, with a *P* value of 0.9 (Table 4). There were no statistically significant differences between both groups, as *P* value was not less than 0.05.

There were no intraoperative complications (visceral or vascular injuries) in either group. Regarding postoperative complications, no other early complications were reported in either group. In group A, two (4.4%) patients complained of urinary retention, six (13.3%) patients complained of seroma, two (4.4%) patients complained of hematoma, two (4.4%) patients complained of wound infection, five (11%) patients complained of scrotal edema and

bruising, and one (2%) patient complained of orchitis. In group B (Lichtenstein repair), two (4.4%) patients complained of urinary retention, seven (15.5%) patients complained of seroma, one (2%) patient complained of hematoma, three (6.5%) patients complained of wound infection, three (6.5%) patients complained of scrotal edema and bruising, and no patients complained of orchitis. For early postoperative complications such as urine retention, wound infection, seroma and hematoma, and scrotal swelling, there were no statistically significant differences. No recurrence occurred in any patient after 18 months of follow-up in either group. Table 5 demonstrates the postoperative complications in both groups.

Pain in the immediate postoperative period (POD 0) was slight in both groups (mean VAS scores of 3.9 and 4.1 in groups A and B, respectively). A total of 17 (37.7%) patients in group A and 15 (33.3%) patients in group B required no medication, whereas the remaining in both groups were administered nonsteroidal analgesics.

Average VAS score during the first postoperative week was 2–3 in both groups and patients who needed analgesics were 10 (22%) in group A and 12 (26.6%) in group B. During the second and third postoperative weeks, eight (17.7%) patients in group A and 12 (26.6%) patients still in group B still complained of slight pain referred to the wound. None of patients in group A and three (6.5%) patients in group B took medication. Using activity assessment scale and PIF revealed that 17 (37.7%) patients in group A and 22 (48.8%) patients in group B experienced limitations of normal activities during the first week. A total of 30 (66.6%) patients engaged in sports between 7 and 21 days after surgery (Table 6).

At 6-month follow-up, it was reported that the rate of PIF after modified method (group A) was five (11%). This rate was eight (17.7%) after Lichtenstein repair (group B). Pain results at 1-year follow-up showed three (6.5%) of patients operated with the new procedure experienced various degrees of pain 1 year after operation. In the other group (Lichtenstein repair), patients with pain reached to six (13.3%) patients. Pain ranged from mild pain or sensation of foreign body to moderate or severe pain (VAS 4–10) that impaired life activities and work and the patients may need medication. *P* value was 0.01, so there was statistically significant difference in chronic pain 1 year after surgery between both groups. Moreover, follow-up results at 18 months revealed two (4.4%) patients in group A and five (11%) patients in group B experienced chronic pain and discomfort at the inguinal region, and also there was a statistically significant difference between groups A and B. Results of follow-up for late pain are shown in Table 7.

Table 5 Postoperative complications in both groups

Postoperative complications	Group A [*n* (%)]	Group B [*n* (%)]
Urine retention	2 (4.4)	2 (4.4)
Seroma	6 (13.3)	7 (15.5)
Hematoma	2 (4.4)	1 (2)
Wound infection	2 (4.4)	3 (6.5)
Genital area edema or bruising	5 (11)	3 (6.5)
Orchitis	1 (2)	0

Group A: patients with modified Lichtenstein technique. Group B: patients with traditional Lichtenstein repair.

Table 6 Early postoperative pain in both groups

Early postoperative pain	Group A	Group B
Mean VAS in POD 0	3.9	4.1
Patients not needed analgesic in POD 0	17	15
Patients needed analgesic in POD 0	28	30
Patients needed analgesic in POD 7	10	12

Group A: patients with modified Lichtenstein technique. Group B: patients with traditional Lichtenstein repair. POD, postoperative day; VAS, visual analogue scale.

Table 7 Late postoperative pain in both groups

Late postoperative pain	Group A	Group B
PIF in first month	17 (37.7)	22 (48.8)
PIF after 6 months	5 (11)	8 (17.7)
Patients with pain after 1 year	3 (6.5)	6 (13.3)
Patients with pain after 18 months	2 (4.4)	5 (11)

Group A: patients with modified Lichtenstein technique. Group B: patients with traditional Lichtenstein repair. PIF, pain-related impairment of function.

Discussion

Use of tension-free hernioplasty markedly reduced recurrence rate of inguinal hernia, so these techniques became the standard in hernia repair surgery. Polypropylene mesh was chosen for Lichtenstein operation owing to its capacity of inducing proper inflammatory and fibrotic responses with rapid and strong adhesion to tissues [9,10,13]. The fibroblastic reaction with transversalis fascia, immediately takes place because of the absence of dead space, but it also occurs with other canal contents. Mesh hernioplasty has gained widespread acceptance owing to its superior outcome in terms of reduced recurrence rates, which are in the range of 1–2%. The Lichtenstein mesh hernioplasty is currently

the most popular operative technique for open repair of inguinal hernia [10,13,14]. According to many studies, excessive fibrosis in the inguinal canal between mesh and canal structures including ilioinguinal and iliohypogastric nerves after inguinal hernioplasty is supposed to be responsible for chronic postoperative pain that may affect daily activities [15].

Although high success rates of Lichtenstein mesh hernioplasty have been reported, the incidence of postoperative chronic neuralgia is not uncommon [16]. This led surgeons to do new procedures with the use of mesh to control postoperative pain and abnormal sensation [15–17]. Based on the guidelines of the International Association for the Study of Pain, chronic postsurgical pain is defined as a pain lasting at least 2 months following the insult, after having ruled out other causes for pain and the possibility of it being the continuation of a pre-existing problem [18]. Other authors suggested increasing this time period to 3–6 months following surgery, which is more consistent with the most widely accepted definition of chronic pain (3 months), and allows for longer follow-up of the patient's functional status. In view of the aforementioned suggestion, the 2-month cut-off point might correspond to a continuum between acute postoperative pain and chronic postsurgical pain [19].

In most cases, postoperative pain is usually temporary and controlled by analgesics. If persist (3–6 months) after surgery, pain could be disabling and may compromise the patient's work and daily activities [20]. Pain is mainly related to the presence of the mesh in the sub-fascial space producing its contact with the cord contents and muscular and nervous structures in the canal. Chronic pain also may be owing to entrapment of nerves by a sub-fascial fibrosis induced by the prosthesis. This leads to neuralgia and chronic discomfort related to the wound and inguinal area [21]. This led to the setting of guidelines for prevention and treatment of this situation [22].

In studies conducted by Demirer *et al.* [23] on animal models (rabbits), polypropylene mesh was inserted close to ilioinguinal nerve and then samples of nerve were taken 3 months after operation. During re-operation, dense fibrous tissues were encompassing the mesh with marked adhesions to surroundings, so removal of ilioinguinal nerve was done with difficulty owing to fibrotic changes. The nerve thickened and adherent to mesh. Macroscopic and microscopic examination of dissected nerves showed peripheral neuropathic changes such as axonal dilatation, lack of myelinated axons, endoneuronal edema, seperated myelin layers, increased diameters of fiber and axon, and high G-ratio. This neuropathic changes are supposed to be present in humans and to have a major role in the etiology of persistent pain after inguinal hernioplasty.

Uzzo *et al.* [24] demonstrated incidence (a traumatic neuroma) in the form of inflammatory demyelinative peripheral neuropathic changes with entrapment of ilioinguinal nerve. Mechanical compression of nerves was associated with myelin sheath degeneration, endoneuronal and perineural edema, and thickening of collagen layer surrounding axons (onion bulb formation).

It is believed that myelinic degeneration and perineural alterations are due to contact between nervous tissues and mesh. Therefore, there is a necessity of identifying and dissecting sub-fascial nerves and even of dividing them to avoid chronic pain [25].

New surgical techniques and modifications were proposed in an attempt to reduce postoperative neuralgia causing pain. The results of these new procedures were not completely satisfactory until now [3,14,15,17,26]. Dissection of nerves during surgery was also proposed, but the resulting abnormal sensations in the areas supplied by the affected nerves limited the benefits of the studies [3,22–26]. So, there is no consensus on certain method with minimal pain to be used, and Lichtenstein repair is still considered one of the most widely accepted and used methods despite the non-negligible percentage of patients with postoperative pain [10,13,14].

The technique proposed in this study is simple and guarantees hospital discharge and return to normal activities which is comparable to those of traditional repair. The technique allows coverage of the mesh by the fibro-cremasteric sheath, which isolates the prosthesis from the cord content and nerves of the canal and prevents contact with surrounding structure.

The principle of covering the mesh by fibro-cremasteric sheath was proposed as a step in other new procedures as all-in-one procedure proposed by Guttadauro *et al.* [27]. But these techniques were not widely assessed until now. Additionally special types of meshes are used which means more financial loads.

The traditional technique of Lichtenstein uses a prosthesis which is fixed to the sides of the canal

over the transversalis fascia under the external oblique aponeurosis [2]. In the study, the prosthesis is fixed by nonabsorbable sutures in the same way on the transversalis fascia, so the goal is to study benefits of mesh covering by autologous layer to prevent contact with nervous and other inguinal canal structure.

As the mesh is covered with the fibro-cremasteric sheath, it is not directly under-aponeurotic. It stays in place as it is fixed properly to the sides to avoid the high rates of mesh migration noticed with the sutureless techniques. In addition, the mesh is not in contact with the nerves, ilioinguinal and ilio-hypogastric nerves, to avoid neuropathy and neuralgia [3,13,14,17,20–27].

In this study, the average operative time was slightly longer than that of traditional repair as there are extra steps including dissection of the cremaster, creation of fibromuscular layer, and fixation of that layer over the mesh. This extra time is supposed to be reduced with increased handling and curve of learning of the operating surgeons.

None of patients had intraoperative complications or recurrence, which may be owing to small number of patients in this study and also owing to experience of the surgeon. In most literature studies, the incidence of intraoperative complications was low owing to increased learning curve of hernioplasty in most centers [2,13,15,23,26–28].

The postoperative complications, other than pain, were nearly similar in both groups as the main idea of repair had not been changed in the modified technique which had an extra step to control pain. Two more cases of testicular edema were found in the new technique group, which may be owing to excessive dissection in those cases, but still was statistically insignificant, needing for more study on a larger number of patients to get reliable results. The complication rates were comparable to the literature [13,17,21,27,28].Many studies were held to compare different methods and techniques with Lichtenstein repair regarding pain and other postoperative complications. Results may be helpful in reduction of postoperative pain in many literature studies; however, larger studies are needed to assess those methods. In the study of Elmaksoud *et al.* [15] Modified Darn repair showed a less early and late postoperative pain on the VAS and after 1-year follow-up with no significant differences in hospital stay and time to return to work and normal activities. They concluded that Modified Darn repair as a tension-free repair is comparable to Lichtenstein repair with less postoperative pain.

Bittner *et al.* [4] demonstrated that the transabdominal preperitoneal laparoscopic repair procedure using lightweight mesh that is fixed by glue is effective in prevention of chronic inguinal pain after operation. In addition, they proposed fibrin fixation as a superior method to clip fixation for the early postoperative pain.

Guttadauro *et al.* [27] used cremasteric fibromuscular sheath to cover the mesh in the all-in-one repair they proposed in 2017. They showed that slight pain was noticed by most cases and 47.6% of patients did not receive medication after discharge. They reported that 96.8% of cases had no pain and no limitation of domestic activities or work and assumed that there was no postoperative neuralgia.

Gedam *et al.* [29] compared Desarda's repair (which does not use a mesh) with standard Lichtenstein repair in inguinal hernia treatment and the results of both methods were similar. Moreover, patients of Desarda's procedure had a sooner recovery and less postoperative pain and complications than those of Lichtenstein mesh repair.

In this study, the early postoperative pain showed a minimal nonrelevant reduction in the mean VAS score in the modified technique group in the first 24 h after surgery. This findings need more experiences to get more data in the early postoperative period on a large number of patients.

On the contrary, the modified technique group had a significant reduction in postoperative chronic pain at 1, 3, 6, 12, and 18 months of follow-up, in the form of less foreign body sensation, less acute disabling pain, and less affection on sexual activity. This was associated with reduction in absence from work and pain medication use, with more satisfaction with the surgery in this group.

So, this technique, despite more time consumption and needing more experience in dissection of inguinal region to preserve the nerves and avoid injuries to cord contents, has no observed complications and decreases the chronic postoperative pain.

However, follow-up in this study was only a mid-term follow-up for 18 months and patients included were of limited number. More clinical trials on larger number of participants with a much longer follow-up time are required to assess the validity of the new procedure.

Conclusion

The available results of the new modification suggest that it may be superior or at least comparable to the Lichtenstein procedure in terms of reduction of chronic postoperative pain as the prosthetic mesh was placed with no contact with nerves and cord, avoiding postoperative neuralgia and foreign body sensation . The procedure indicates no increased risk of complication compared with the Lichtenstein procedure. However, larger studies with long-term follow-up are needed to assess this technique and compare it with the most common techniques.

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Conflicts of interest

There are no conflicts of interest.

References

1 Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. *Lancet* 2003; **362**:1561–1571.

2 Lichtenstein IL, Shulman AG, Amid PK, Montllor MM. Cause and prevention of postherniorrhaphy neuralgia: a proposed protocol for treatment. *Am J Surg* 1988; **155**:786–790.

3 Campanelli G, Sfeclan C, Cavalli M, Biondi A. Reducing postoperative pain: the use of Tisseel for mesh fixation in inguinal hernia repair. *Surg Technol Int* 2012; **22**:134–139.

4 Bittner R, Gmähle E, Gmähle B, Schwarz J, Aasvang E, Kehlet H. Lightweight mesh and noninvasive fixation: an effective concept for prevention of chronic pain with laparoscopic hernia repair (TAPP). *Surg Endosc* 2010; **24**:2958–2964.

5 Amato B, Moja L, Panico S, Persico G, Rispoli C, Rocco N, Moschetti I. Shouldice technique versus other open techniques for inguinal hernia repair. *Cochrane Database Syst Rev* 2009; **4**:CD001543.

6 Chinchilla-Hermida PA, Baquero-Zamarra DR, Guerrero-Nope C, Bayter-Mendoza EF. Incidence of chronic post-surgical pain and its associated factors in patients taken to inguinal hernia repair. *Rev Col Anest* 2017; **45**:291–299.

7 Deumens R, Steyaert A, Forget P, Schubert M, Lavand'homme P, Hermans E, De Kock M. Prevention of chronic postoperative pain: cellular, molecular, and clinical insights for mechanism-based treatment approaches. *Prog Neurobiol* 2013; **104**:1–37.

8 Ali SM, Zendejas B, Yadav S, Hernandez-Irizarry RC, Lohse CM, Farley DR. Predictors of chronic groin discomfort after laparoscopic totally extraperitoneal inguinal hernia repair. *J Am Coll Surg* 2013; **217**:72–78.

9 Poobalan AS, Bruce J, King PM, Chambers WA, Krukowski ZH, Smith WCS. Chronic pain and quality of life following open inguinal hernia repair. *Br J Surg* 2001; **88**:1122–1126.

10 Shirah BH, Shirah HA. Lichtenstein mesh hernioplasty for inguinal hernias: simplicity is the ultimate sophistication. *Int Surg J* 2016; **3**:230–236.

11 Fitzgibbons RJ, Forse RA. Groin hernias in adults. *N Engl J Med* 2015; **372**:756–763.

12 Berger D. Evidence-based hernia treatment in adults. *Dtsch Arztebl Int* 2016; **113**:150.

13 Lionetti R, Neola B, Dilillo S, Bruzzese D, Ferulano GP. Sutureless hernioplasty with light-weight mesh and fibrin glue versus Lichtenstein procedure: a comparison of outcomes focusing on chronic postoperative pain. *Hernia* 2012; **16**:127–131.

14 Kapur N, Kumar N. Incidence of chronic pain after single stitch mesh fixation in open inguinal hernia repair: an observational prospective study, a case series. *Int J Surg Open* 2017; **8**:32–35.

15 El Maksoud WA, El Salam MA, Ahmed HH. Comparative study between Lichtenstein procedure and modified darn repair in treating primary inguinal hernia: a prospective randomized controlled trial. *Hernia* 2014; **18**:231–236.

16 Bueno J, Serralta A, Planells M, Rodero D. Inguinodynia after two inguinal herniorrhaphy methods. *Surg Laparosc Endosc Percutan Tech* 2004; **14**:210–214.

17 Barnes JJ. Inguinal hernia repair with routine use of Marlex mesh. *Surg Gynecol Obstet* 1987; **165**:33–37.

18 Macrae WA. Chronic pain after surgery. *Br J Anaesth* 2001; **87**:88–98.

19 Callesen T, Bech K, Kehlet H. Prospective study of chronic pain after groin hernia repair. *Br J Surg* 1999; **86**:1528–1531.

20 Pierides GA, Paajanen HE, Vironen JH. Factors predicting chronic pain after open mesh based inguinal hernia repair: a prospective cohort study. *Int J Surg* 2016; **29**:165–170.

21 Mantha S, Thisted R, Foss J, Ellis JE, Roizen MF. A proposal to use confidence intervals for visual analog scale data for pain measurement to determine clinical significance. *Anesth Analg* 1993; **77**:1041–1047.

22 Alfieri S, Amid PK, Campanelli G, Izard G, Kehlet H, Wijsmuller AR, *et al.* International guidelines for prevention and management of post-operative chronic pain following inguinal hernia surgery. *Hernia* 2011; **15**:239–249.

23 Demirer S, Kepenekci I, Evirgen O, Birsen O, Tuzuner A, Karahuseyinoglu S, *et al.* The effect of polypropylene mesh on ilioinguinal nerve in open mesh repair of groin hernia. *J Surg Res* 2006; **131**:175–181.

24 Uzzo RG, Lemack GE, Morrissey KP, Goldstein M. The effects of mesh bioprosthesis on the spermatic cord structures: a preliminary report in a canine model. *J Urol* 1999; **161**:1344–1349.

25 Bay-Nielsen M, Perkins FM, Kehlet H. Pain and functional impairment 1 year after inguinal herniorrhaphy: a nationwide questionnaire study. *Ann Surg* 2001; **233**:1.

26 Valenti G, Baldassarre E, Testa A, Arturi A, Torino G, Campisi C, Capuano G. Dynamic self-regulating prosthesis (protesi autoregolantesi dinamica): the long-term results in the treatment of primary inguinal hernias. *Am Surg* 2006; **72**:244–248.

27 Guttadauro A, Maternini M, Frassani S, De Simone M, Chiarelli M, Macchini D, Gabrielli F. 'All-in-one mesh' hernioplasty: a new procedure for primary inguinal hernia open repair. *Asian J Surg* 2018; **41**:473–479.

28 Lichtenstein IL. Herniorrhaphy: a personal experience with 6,321 cases. *Am J Surg* 1987; **153**:553–559.

29 Gedam BS, Bansod PY, Kale VB, Shah Y, Akhtar M. A comparative study of Desarda's technique with Lichtenstein mesh repair in treatment of inguinal hernia: a prospective cohort study. *Int J Surg* 2017; **39**:150–155.