Original Article

A Prospective Comparative Study of 3-Stitch Mesh Hernioplasty with Conventional Lichtenstein Repair

Abstract

Background: Hernioplasty, in which a mesh is used to strengthen a weakness or defect in the inguinal wall, has replaced simple tissue repair. As it is associated with low recurrence, it is considered the gold standard and is one of the most common general surgical procedures. The ideal repair should be rapid, safe and simple to do, requires minimal dissection to create sufficient space, be cost-effective and be accompanied by a brief hospital stay, reduced pain, and fewer recurrences. The aim of the present study was to compare the efficacy of 3-stitch mesh fixation with that of traditional Lichtenstein mesh fixation of inguinal hernia repair. **Materials and Methods:** Between July 2018 and December 2019, 59 cases of primary, uncomplicated inguinal hernias were surgically treated. Both the classical Lichtenstein technique (group A, $n = 30$) and the Lichtenstein technique with the three-stitch fixation method (group B, $n = 29$) were used on patients with inguinal hernias. Between the two groups, the mean operative times, post-surgical pain scores, average hospital stays and postoperative complications including recurrence rates were compared. **Results:** With a *P*-value of 0.001, the 3-point fixation group (group B) took 3.41 ± 0.58 min less time to fix the mesh than the Lichtenstein group (group A, 5.52 ± 0.59 min). The pain after surgery was much less for participants who had 3-point mesh fixation than for those who had conventional mesh fixation in the early (1, 3, 7 and 15 days after surgery) and late (1 month and 3 months) postoperative periods, with a *P*-value of 0.0001. When compared to the classical mesh fixation group, the 3-point mesh fixation group had less urinary retention, seroma and swelling. Both groups had the same number of other complications. **Conclusions:** The three-point hernioplasty is a simple procedure that is easier to adopt, less time-consuming, causes less trauma and has a lower risk of postoperative discomfort including chronic groin pain.

Keywords: *3-point mesh repair, chronic groin pain, inguinal hernia, Lichtenstein hernioplasty, recurrence*

Pankaj Kumar Sharma, Manish Khandelwal, Dharmendra Kumar Pipal[1], Yatindra Singh[2], Saurabh Kothari[3], Vijay Verma[2], Seema Yadav[4], Bhupendra Singh[5], Gurusha Jangid[6]

Department of General Surgery, Government Medical College, Kota, Rajasthan, [1]Department of General Surgery, All India Institute of Medical Sciences, Gorakhpur, Uttar Pradesh, [2]Department of General Surgery, Dr S N Medical College, Jodhpur, [3]Department of General Surgery, Geetanjali Medical College and Hospital, Udaipur, [4]Department of Anesthesiology, JNU Medical College and Hospital, Jaipur, Rajasthan, [5]Department of Anesthesiology, All India Institute of Medical Sciences,, Raebareli, Uttar Pradesh, [6]Dr S N Medical College, Jodhpur, Rajasthan,India

Received: 26-Feb-2023
Accepted: 02-May-2023
Published: 16-Sep-2023

Address for correspondence:
Dr. Dharmendra Kumar Pipal, Department of General Surgery, All India Institute of Medical Sciences, Gorakhpur, Uttar Pradesh, India.
E-mail: dr.dharmendrapipal2007@gmail.com

Access this article online

Website: www.jwacs-jcoac.com

DOI: 10.4103/jwas.jwas_49_23

Quick Response Code:

Introduction

Repair of inguinal hernia is one of the various commonly performed general surgical procedures. There were several ways to fix it before tension-free Lichtenstein repair was developed, which has become the gold standard approach and is of the utmost importance given the patient's comfort and low recurrence rate.[1]

Approximately 3%–8% population is suffering from various hernias. As far as the inguinal hernia is concerned, 50% belong to the indirect one, 25% is direct, and 5% is femoral. In men, 86% are inguinal hernias, and 84% of total femoral hernias are reported in women, although inguinal hernias are the most common in both men and women.[2]

By employing polypropylene mesh and popularising tension-free open repair, Lichtenstein claimed a 99% chance of a permanent cure along with a quicker recovery and return to work. After its initial publication in 1989, Lichtenstein hernioplasty quickly gained acceptance as a standard method for open surgical repair due to its low recurrence, safety and effectiveness.

Chronic groin pain (CGP), with a documented incidence ranging from 0.7% to 62.9%, is a challenge for surgeons associated with Lichtenstein repair despite the excellent outcome in terms of low recurrence.[3] Tension-free approaches have reduced postoperative pain and resulted in low recurrence rates.[4]

How to cite this article: Sharma PK, Khandelwal M, Pipal DK, Singh Y, Kothari S, Verma V, *et al.* A prospective comparative study of 3-stitch mesh hernioplasty with conventional Lichtenstein repair. J West Afr Coll Surg 2023;13:67-72.

Hernial recurrence, CGP, hospital stay, recovery time and complications are considered when evaluating therapeutic outcomes of hernia repair. These results are strongly influenced by surgical methods, patient characteristics, mesh type and fixation methods.[5] Sutures, staples or tacks have typically secured polypropylene, Dacron or Marceline prosthetic mesh. However, a study found that unfixed mesh-based repairs of an inguinal hernia caused less pain and discomfort following surgery than those repaired using tackers for fixing the mesh, suggesting that fixation device placement may induce chronic postoperative pain. This suggests that mesh placement should be unfixed.[6] Fixing the mesh or not is a debatable issue. In patients having an open surgical repair of a hernia, CGP following surgery has a multifactorial occurrence. Nerve excision, suture compression on the nerve, foreign-body sensation or reaction secondary to the mesh, stress on muscle fibres and other factors can all produce pain. Therefore, fixing or not fixing the mesh is a debatable issue as on one hand without any fixation the fear of mesh migration and recurrence is there, on the other hand, fixation with multiple sutures is associated with CGP. Hence, reducing the number of fixations can address both issues.

This study compared the outcomes of two groups of Lichtenstein mesh hernioplasty, group A with traditional suture fixation and group B with 3-point fixation, in terms of the length of surgery, the amount of postoperative pain, the length of hospitalisation, postoperative complications and the likelihood of recurrence.

Materials and Methods

This was a prospective randomised study and was conducted in the Department of General Surgery, at Maharao Bhim Singh hospital attached to Government Medical College, Kota following the approval of the institutional ethical committee over a period of 18 months, from July 2018 to December 2019.

A total of 59 patients were enrolled in the study, and following randomisation using the closed-envelope method, they were divided into two groups.

Group A ($n = 30$): Participants operated by the conventional method of mesh fixation in Lichtenstein's procedure.

Group B ($n = 29$): Participants were operated on by fixing the mesh at a 3-point.

Only patients with unilateral or bilateral inguinal hernias between the ages of 18 and 60 were included in the study, but those with complicated or recurrent hernias, those treated laparoscopically, those taking chronic steroids, those with coagulopathy, those receiving chemotherapy, and those with connective tissue disorders were excluded.

In group B, the pubic tubercle, the inguinal ligament 1.5 cm lateral to the first stitch, and the medial most portion of the conjoint tendon were the three places where the mesh was secured using nonabsorbable monofilament polypropylene thread. After ensuring that the bite was tissue-free, two ends of the mesh were sutured to one another at the deep ring.

Follow-up was done up to 3 months postoperatively in both groups. It was done 15 days, 1 month and 3 months after surgery, and recurrence or the death of the patient was considered the end point of follow-up.

The comparison was done by analysing the mean time taken for surgery, that is, mean operative time, duration of hospital stays, any complications encountered and the pain. After explaining it to the patients, the pain was assessed using the visual analogue scale (VAS). Analgesics were given to the patients if the score was 3 or more. It was calculated between 12 and 24 h following hernioplasty. After discharge, all patients were followed up on the 7th day to assess any seroma or hematoma formation, scrotal oedema or mesh migration, while paraesthesia, neuropraxia or recurrence were observed after 1 month and 3 months.

Statistical analysis

SPSS, a statistical software program for Windows (SPSS Inc., Chicago, Illinois), was used to do the statistical analysis and analyse the data. Graphs, tables and other types of data have been created using Microsoft Word and Excel. The quantitative data were presented as mean and standard deviation and were compared by students' *t* test. Probability was considered to be significant if less than 0.05.

Results

In groups A and B, respectively, the Lichtenstein technique and the three-point fixation approach were used to treat a total of 59 patients with uncomplicated inguinal hernias. Operative time, postoperative pain, hospital stay, any complications following the surgery and recurrence rate are the most significant factors that are compared between the two groups. Patients in group A ($n = 30$) had a mean age of 43.60 ± 11.37 years, whereas those in group B ($n = 29$) had a mean age of 49.41 ± 7.72 years [Table 1]. Statistics showed that the difference was not significant. In both groups, there were solely male patients. Samples are age-matched with *P*-value = 0.086 estimated by student *t* test. In group A, 15 (50%)

Table 1: Demographic parameters

Parameters		Group A ($n = 30$)	Group B ($n = 29$)	*P*-value
Mean age (mean ± SD)		43.60 ± 11.37	49.41 ± 7.72	0.086
Gender	Male	30	29	
	Female	0	0	
Side	Right	15 (50%)	12 (41.38%)	0.733
	Left	11 (36.67%	14 (48.28%)	
	B/L	4 (13.33%)	3 (10.34%)	
Type	Direct	9 (30%)	14 (48.28%)	0.241
	Indirect	21 (70%)	15 (51.72%)	

of cases were right-sided and 11 (36.67%) were left-sided, whereas in group B, 12 (41.38%) patients and 14 (48.28%) patients had right- and left-sided hernias, respectively [Table 1]. Four (13.33%) and three (10.34%) patients in groups A and B had bilateral hernias, respectively ($\chi^2 = 3.513$ with 5 degrees of freedom with *P*-value = 0.733). In group A, 21 (70%) patients had an indirect hernia, and 9 (30%) had a direct hernia, whereas in group B, 15 (51.72%) patients had an indirect hernia, and 14 (48.28%) had a direct hernia (*P*-value = 0.241). No cases had both direct and indirect hernias. In this study, the mean operative time difference between groups A and B was 5.12 minutes (*P*-value = 0.001) [Table 2].

Table 2 : Duration of surgery

Operative parameters	Group A	Group B	*P*-value	Difference in time in minutes
Time taken from skin incision to beginning of mesh fixation (mean ± SD, min)	24.60 ± 2.50	23.93 ± 2.20	0.280	0.67
Time taken in fixation of mesh (mean ± SD, min)	5.52 ± 0.59	3.41 ± 0.58	0.021	2.11
Total duration of surgery (mean ± SD, min)	37.23 ± 2.88	32.11 ± 2.49	0.001	5.12

Table 3: Comparison of VAS score in two groups

VAS score	Group A	Group B	*P*-value
POD 1 (mean ± SD)	3.30 ± 0.70	2.31 ± 0.76	0.012
POD 3 (mean ± SD)	2.30 ± 0.70	1.34 ± 0.55	0.002
POD 7 (mean ± SD)	1.60 ± 0.67	0.76 ± 0.64	0.001
POD 15 (mean ± SD)	0.83 ± 0.70	0.21 ± 0.41	0.0001

As per Table 3 and Figure 1, on post-operative day (POD) 1, the mean VAS score in group A was 3.30 ± 0.70, whereas that in group B was 2.31 ± 0.76. This difference in the mean VAS score is statistically significant with a *P*-value < 0.001. On POD 3, the mean VAS score in group A was 2.30 ± 0.70, whereas that in group B was 1.34 ± 0.55 which was statistically significant with a *P*-value < 0.001. On POD 7, the mean VAS score in Group A was 1.60 ± 0.67, whereas that in group B was 20.76 ± 0.64 which was statistically significant with a *P*-value < 0.001. On POD 15, the mean VAS score in group A was 0.83 ± 0.70, whereas that in group B was 0.21 ± 0.41. This difference in the mean VAS score is statistically significant with a *P*-value < 0.001. Upon discharge, both groups of patients were given a 3-month follow-up that included routine out-patient department checks at 1 and 3 months. Chronic pain was found by looking at the patient's medical history and how often they used analgesics to relieve the pain. After a month, nine patients in group A and one patient in group B reported uncomfortable groin pain when performing activities near the surgical site with a *P*-value of 0.018 [Table 4]. At the end of 3 months after surgery, six patients in group A complained of groin pain which persisted despite pain medication whereas no patients in group B have such complaints. The *P*-value was 0.031 [Table 4]. Though, the difference between the two groups was statistically significant in this small cohort group, in which the incidence of chronic pain was significantly higher in group A.

Both groups experienced a variety of postoperative complications, including the development of seromas or hematomas, induration and oedema at and around the surgical site, wound gapping, mesh infection, persistent groin pain, recurrence, etc. Among the postoperative complications encountered in the present study, urinary retention, induration and swelling were lesser in group B whereas seroma, hematoma and wound gap rates were nil in group B. Recurrence was noted in one patient in group B, although it was not significant (*P*-value = 0.487, Table 5). In the present study, the mean duration of post-op hospital

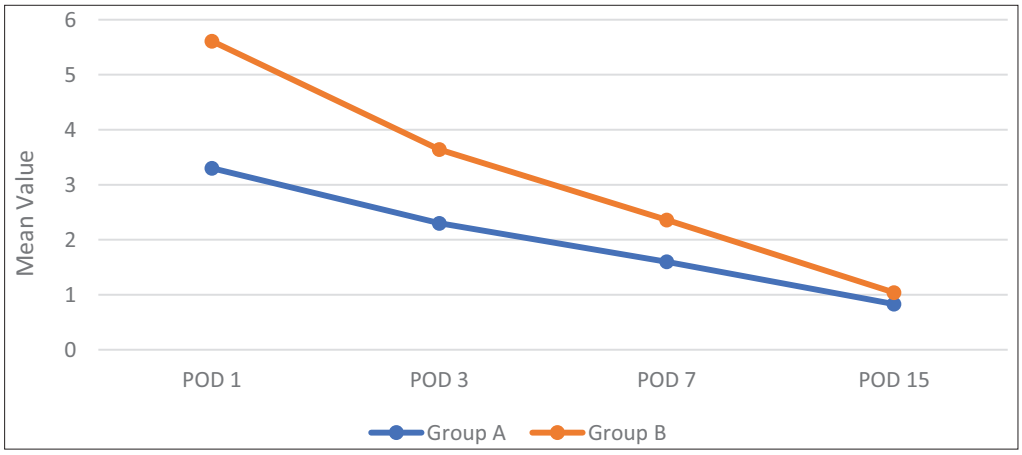

Figure 1: Visual analog scale on various postoperative days

Table 4: Comparison of incidence of chronic groin pain at 1 month and 3 months

	Group A		Group B		*P*-value
	No.	%	No.	%	
1 month					
No	21	70.00	28	93.33	0.018
Yes	9	30.00	1	3.33	
3 months					
No	24	80.00	30	100.00	0.031
Yes	6	20.00	0	0.00	

Table 5: Complications in two groups

	Group A (n = 30)		Group B (n = 29)		*P*-value
	No	%	No	%	
Urinary retention	4	13.33	2	6.67	0.699
Induration and swelling	5	16.67	2	6.67	0.449
Seroma	3	10.00	0	0.00	0.248
Hematoma	0	0.00	0	0.00	–
Wound gap	1	3.33	0	0.00	0.986
Mesh infection	0	0.00	0	0.00	–
Recurrence	0	0.00	1	3.33	0.986
Chronic groin pain	2	6.67	0	0.00	0.487

stay was 4.43 ± 1.45 and 4.10 ± 1.26 days, respectively [Table 6, Figure 2]. Value was statistically insignificant.

Discussion

Lichtenstein mesh hernioplasty, however, is considered the gold standard but is associated with postoperative pain. This could be because it is based on anchoring mesh with multiple nonabsorbable sutures, which could cause nerve and muscle fibre entrapment.[7-13] This postoperative pain is very disturbing to patients and associated with 0%–42% of patients operated for hernioplasty by Lichtenstein procedure.[14] Other factors responsible for chronic pain include the competency and experience of the surgeon, local complications such as seroma or hematoma formation, and the implantation of synthetic material. The development of CGP is an area of concern as it is associated with long-term morbidity and offsets the benefit of recurrence, and therefore requires further study and modification of the technique of repair.[15] Hence, the aim of the present study was to compare the 3-point fixation of mesh in Lichtenstein repair to the conventional fixation.

The three-stitch hernioplasty method takes advantage of the mesh's stiffness, flat shape memory and stickiness when it is placed in a closed anatomical space. This keeps the mesh from wrinkling, curling, folding or migration. It has a number of practical and clinical benefits, such as minimal

Table 6: Postoperative stay

Postoperative stay (days)	Group A		Group B	
	No.	%	No.	%
1–2	3	10.00	3	10.34
3–6	24	80.00	25	86.20
7–12	3	10.00	1	3.44
Mean ± SD	4.43 ± 1.45		4.10 ± 1.26	
P-value	0.356			

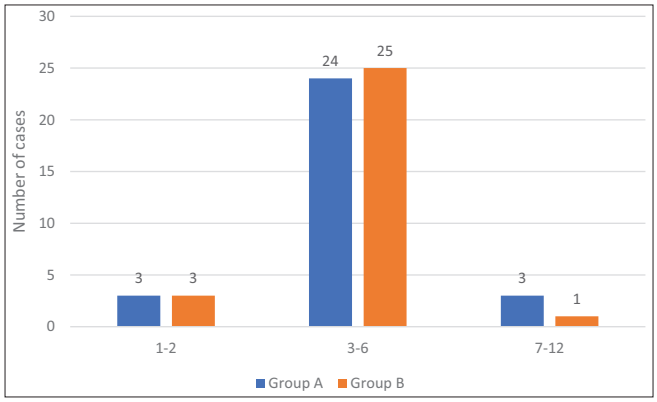

Figure 2: Postoperative stay

anchoring of the mesh to the surrounding tissue and limited surgical dissection, which make the procedure less painful and reduce the risk of infection.[16,17]

In the present study, the mean age of presentation in group A was 43.60 ± 11.37 and in group B was 49.41 ± 7.72. This was compared with the results in other studies and correlated well with Kim-Fuchs *et al.*,[18] which reported 55.4 years of mean age. Only male patients were included in the present study. The distribution of hernia types in the current study was different from other studies such as Testini *et al.*'s,[19] which found right indirect inguinal hernia as the most common type. Whereas group B showed a predominance of left-indirect inguinal hernia in the current study, group A showed a predominance of right indirect inguinal hernia. However, research by Ersoz *et al.*[2] found that left-indirect inguinal hernias were more common.

The mean time difference between groups A and B in relation to the operative time in the current study was 5.12 min. Group B underwent surgery for a shorter period of time. The average time difference between Kim-Fuchs *et al.*[18] and Singh *et al.*[20] was 7 min and 10 min, respectively. As a result, our study's difference was quite less and more significant than that of the other two studies.

In the present study, group B's VAS scores on postoperative days 1, 3, 7 and 15 were significantly lower than those of group A. In Testini *et al.*'s study,[19] immediate postoperative pain following the traditional Lichtenstein repair was greater than in group B cases. In his study, Lionetti *et al.*[21] compared Lichtenstein hernioplasty with hernioplasty without sutures and claimed that suture-free hernioplasty

led to much lower average VAS scores than Lichtenstein hernioplasty.

Among the postoperative complications encountered in the present study, urinary retention, induration and swelling were less common in group B, while seroma and differences in wound gap rates were nil in group B. Testini *et al.*[19] and Munghate *et al.*[22] discovered a difference in urinary retention and hematoma rates while remaining consistent in the other parameters.

The current study's mean postoperative hospital stays in groups A and B were 4.43 ± 1.45, and 4.10 ± 1.26 days, respectively. Owing to the varying operational definitions of these variables in other studies, it was not possible to compare this parameter with those in other studies. This was because the current study is an institutional one and patients in both groups had to wait a comparable amount of time for the government program to be approved; therefore, the number of days spent in the hospital was about the same in both groups. However, group B showed a consistent trend of earlier mobilisation. Additionally, the length of a hospital stay can vary greatly depending on a number of variables, including the patient's wishes, the expense of the stay, the advice of the doctor, etc. Inguinal hernia repairs are now frequently performed as day surgery in hospitals; therefore, the overall length of hospitalisation is not as important as it once was.

This study found that 30% of participants in group A were experiencing chronic pain, while only 3.3% of those in group B were experiencing the same. Patients in group B had no cases of chronic pain after 3 months of follow-up, compared to 6% in group A. Postoperative pain that persists for longer than 3 months is considered chronic groin pain and is a major contributor to patient morbidity. The pain was rated using a VAS score, with 0 indicating no pain, 1–5 indicating moderate pain, and 6–10 indicating severe pain. None of the participants in group B experienced persistent groin pain over the course of the study.

Recovery is slowed because of the high amount of discomfort felt by the patient at the site and also around the edges of the prosthesis due to tissue damage and strain.[23] According to a study conducted in 1988 by Lichtenstein *et al.*,[24] 2% of people experience chronic groin pain. Another study found that just 1% of 104 patients who underwent laparoscopic hernia repair experienced chronic groin pain after the procedure was completed in 1994 by Panton and Panton.[25] For participants in Group B, there was no evidence of chronic groin pain in the present study.

A study done in 2010 by Jaiswal *et al*.[26] found that the low rate of CGP was due to the careful identification and preservation of nerves, the use of absorbable sutures to fix the mesh, and the use of the fewest possible sutures to fix the mesh.

In the present study, there was one recurrence in Group B, and similar recurrence rates were seen in many other studies, including those by Kim-Fuchs *et al*.,[18] Testini *et al*.,[19] and Ersoz *et al*.[2] Our study's recurrent patient was diabetic and had a big defect with weakened fascia-aponeurotic fibres. This study found a 3.33% recurrence rate; however, it only followed patients for 18 months. It takes at least 5 years of investigation to determine the effectiveness of any type of hernioplasty because only 50% of recurrences will occur in the first 2 years.

Limitations

This study has some limitations, including a small study group size and a 3-month-long follow-up duration. We need to do large, multicentre studies with longer follow-up times to back up the findings.

Conclusion

Inguinal hernia cases can benefit from the three-point fixation of mesh surgery because it reduces the length of the operation, significantly lessens postoperative pain, and reduces postoperative complications. Even though the risk of nerve entrapment is lower, chronic groin pain is much less likely to happen with 3-stitch mesh fixation than with traditional mesh fixation.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Anadol AZ, Akin M, Kurukahvecioglu O, Tezel E, Ersoy E. A prospective comparative study of the efficacy of conventional Lichtenstein versus self-adhesive mesh repair for inguinal hernia. Surg Today 2011;41:1498-503.
2. Ersoz F, Culcu S, Duzkoylu Y, Bektas H, Sari S, Arikan S, *et al*. The comparison of Lichtenstein procedure with and without mesh-fixation for inguinal hernia repair. Surg Res Pract 2016;2016:8041515.
3. Ladwa N, Sajid MS, Sains P, Baig MK. Suture mesh fixation versus glue mesh fixation in open inguinal hernia repair: A systematic review and meta-analysis. Int J Surg 2013;11:128-35.
4. Köninger J, Redecke J, Butters M. Chronic pain after hernia repair: A randomized trial comparing Shouldice, Lichtenstein and TAPP. Langenbecks Arch Surg 2004;389:361-5.
5. Techapongsatorn S, Tansawet A, Kasetsermwiriya W, Pattanaprateep O, Thakkinstian A. Mesh fixation technique for inguinal hernia repair: Protocol for an umbrella review with integrated and updated network meta-analysis. BMJ Open 2019;9:e031742.
6. Fortelny RH, Petter-Puchner AH, Glaser KS, Redl H. Use of fibrin sealant (Tisseel/Tissucol) in hernia repair: A systematic review. Surg Endosc 2012;26:1803-12.
7. Canonico S, Benevento R, Perna G, Guerniero R, Sciaudone G, Pellino G, *et al*. Sutureless fixation with fibrin glue of lightweight mesh in open inguinal hernia repair: Effect on postoperative pain:

A double-blind, randomized trial versus standard heavyweight mesh. Surgery 2013;153:126-30.
8. Hidalgo M, Castillo MJ, Eymar JL, Hidalgo A. Lichtenstein inguinal hernioplasty: Sutures versus glue. Hernia 2005;9: 242-4.
9. Aasvang E, Kehlet H. Surgical management of chronic pain after inguinal hernia repair. Br J Surg 2005;92:795-801.
10. Amid PK. Classification of biomaterials and their related complications in abdominal wall hernia surgery. Hernia 1997;1:15-21.
11. Katkhouda N. A new technique for laparoscopic hernia repair using fibrin sealant. Surg Technol Int 2004;12:120-6.
12. Lau H. Fibrin sealant versus mechanical stapling for mesh fixation during endoscopic extraperitoneal inguinal hernioplasty: A randomized prospective trial. Ann Surg 2005;242:670-5.
13. Mui WL, Ng CS, Fung TM, Cheung FK, Wong CM, Ma T-H, *et al*. Prophylactic ilioinguinal neurectomy in open inguinal hernia repair: A double-blind randomized controlled trial. Ann Surg 2006;244:27-33.
14. Nienhuijs S, Staal E, Strobbe L, Rosman C, Groenewoud H, Bleichrodt R. Chronic pain after mesh repair of inguinal hernia: A systematic review. Am J Surg 2007;194:394-400.
15. Nienhuijs SW, Boelens OB, Strobbe LJ. Pain after anterior mesh hernia repair. J Am Coll Surg 2005;200:885-9.
16. Conze J, Kingsnorth AN, Flament JB, Simmermacher R, Arlt G, Langer C, *et al*. Randomized clinical trial comparing lightweight composite mesh with polyester or polypropylene mesh for incisional hernia repair. Br J Surg 2005;92:1488-93.
17. Lomanto D, Iyer SG, Shabbir A, Cheah WK. Laparoscopic versus open ventral hernia mesh repair: A prospective study. Surg Endosc 2006;20:1030-5.
18. Kim-Fuchs C, Angst E, Vorburger S, Helbling C, Candinas D, Schlumpf R. Prospective randomized trial comparing sutured with sutureless mesh fixation for Lichtenstein hernia repair: Long-term results. Hernia 2012;16:21-7.
19. Testini M, Lissidini G, Poli E, Gurrado A, Lardo D, Piccinni G. A single-surgeon randomized trial comparing sutures, N-butyl-2-cyanoacrylate and human fibrin glue for mesh fixation during primary inguinal hernia repair. Can J Surg 2010;53:155-60.
20. Singh A, Singh V, Chawla IA. Comparative study between Lichtenstein hernioplasty and Rutkow-Robbins method of hernioplasty for inguinal hernia repair. Ann Int Med Dental Res 2016;2:31-7.
21. 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;16:127-31.
22. Munghate A, Mittal S, Singh H, Singh G, Yadav M. Skin staples: A safe technique for securing mesh in Lichtensteins hernioplasty as compared to suture. Surg Res Pract 2014;2014:958634.
23. Martín-Duce A, Noguerales F, Villeta R, Hernández P, Lozano O, Keller J, *et al*. Modifications to Rives technique for midline incisional hernia repair. Hernia. 2001;5:70-2.
24. Eklund AS, Montgomery AK, Rasmussen IC, Sandbue RP, Bergkvist LA, Rudberg CR. Low recurrence rate after laparoscopic (TEP) and open (Lichtenstein) inguinal hernia repair: A randomized, multicenter trial with 5-year follow-up. Ann Surg 2009;249:33-8.
25. Panton ON, Panton RJ. Laparoscopic hernia repair. Am J Surg 1994;167:535-7.
26. Jaiswal LC, Chaudhry BR, Agrawal MA. Chronic groin pain following Lichtenstein mesh hernioplasty for inguinal hernia. Is it a myth? Indian J Surg 2009;71:84-8.