

Comparison between the Preperitoneal Mesh and Lichtenstein's Mesh Repair in Inguinal Hernia Repair

Mohammad Mohsen Salem¹; Eslam Taha Ghalwash² and Mohammad Jamal Mohammad Ammar³

¹Professor of General Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

²Lecturer of General Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

³General Surgery Resident, Ahmed Maher Teaching Hospital, Cairo, Egypt

muhammadjamalammar@gmail.com

Abstract: Introduction: The Lichtenstein technique is currently one of the popular methods in practice as it provides very good results consistently. However many patients suffer from wound complications and chronic wound pain which are often underreported. The preperitoneal technique avoids these complications by placing the mesh in preperitoneal plane either by laparoscopic approach or open approach. **Patients and Methods:** It is a prospective randomized controlled study. It includes fifty patients divided into two groups, during the period from November 2017 till August 2018. **The first group (A)** includes twenty five patients and were operated using a preperitoneal mesh by a Laparoscopic trans-abdominal preperitoneal inguinal hernioplasty technique and open trans inguinal preperitoneal repair. While **the second group (B)** includes twenty five patients and were operated upon by a Lichtenstein's Tension-Free Repair. **Results:** Patients in the preperitoneal group had less persisting pain in post-operative period ($p = 0.04$), less hospital stay ($p = 0.012$). Operative time was shorter in preperitoneal group but with no statistical significance. There was no recurrence in either group. **Conclusion:** This study shows that the preperitoneal approach provides a better alternative to Lichtenstein technique with decreased incidence of wound complications and chronic groin pain, while having a similar recurrence rate. So we recommend the preperitoneal approach in the inguinal hernia repair as an alternative to traditional Lichtenstein's method.

[Mohammad Mohsen Salem; Eslam Taha Ghalwash and Mohammad Jamal Mohammad Ammar. **Comparison between the Preperitoneal Mesh and Lichtenstein's Mesh Repair in Inguinal Hernia Repair.** *Nat Sci* 2018;16(10):89-97]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). <http://www.sciencepub.net/nature>. 13. doi:[10.7537/marsnsj161018.13](https://doi.org/10.7537/marsnsj161018.13).

Keywords: Comparison; Preperitoneal Mesh; Lichtenstein's Mesh Repair; Inguinal Hernia Repair

1. Introduction

The anteriorabdominal wall hernias occupy a good deal of surgical time and account for 10–15% of all surgical operations. The majority of operations (80%) are performed for inguinal hernias, although this figure is even higher in the male population. The remainder are in the region of the umbilicus (8%), incisional (7%) and femoral hernias (5%) (Cuschieri et al., 2015).

Seventy-five percent of all abdominal wall hernias are found in the groin, making it the most common location for an abdominal wall hernia. Of all groin hernias, 95% are hernias of the inguinal canal with the remainder being femoral hernia defects. Inguinal hernias are nine times more common in men than in women. Although femoral hernias are found more often in women, the inguinal hernia is still the most common hernia in women. The overall lifetime risk of developing a groin hernia is approximately 15% in males and less than 5% in females (Patrick et al., 2013).

The pre-peritoneal approach is more effective than the traditional anterior herniorrhaphy because a repair in the pre-peritoneal plane fixes the hernia defect in the space between the hernia contents and the hernia defect. In contrast, the anterior approach does

not keep the hernia contents from contact with the defect, but rather fixes the hernia defect anterior to the defective anatomy. The operation is also advocated for difficult inguinal hernia recurrences, since the posterior approach will usually remain open and without scar following a previous anterior hernia repair (Greenberg, 2013).

Lichtenstein technique is a standard procedure for open tension free inguinal hernia repair performed using prosthetic mesh in front of the defect to strengthen posterior wall of inguinal canal (Amid, 2004).

Pre-peritoneal mesh placement is an effective approach to decrease post-operative pain resulting from extensive dissection of inguinal canal for Lichtenstein's tension free mesh repair and less manipulation of the inguinal nerves unlike pre-peritoneal mesh which it is held in place by intra-abdominal pressure. Placing a pre-peritoneal mesh over the myopectineal orifice of Fruchaud will repair all types of groin hernia simultaneously, and without additional incisions or dissection (Skandalakis, 2014).

Moreover, when closing a defect with mesh, there are obvious mechanical advantages to placing the mesh behind the defect (pre-peritoneal) and against the pressures which are creating herniation, rather than

on top of the defect where it can easily be pushed away (Skandalakis, 2014).

2. Patients and Methods

It is a prospective randomized controlled study was conducted at Ahmad Maher Teaching Hospital and El-Hussein University Hospital. It includes fifty patients divided into two groups, during the period from November 2017 till August 2018.

The first group (A) includes twenty five patients and were operated using a preperitoneal mesh by a Laparoscopic trans-abdominal pre-peritoneal inguinal hernioplasty technique and open trans inguinal preperitoneal repair. While **the second group (B)** includes twenty five patients and were operated upon by a Lichtenstein's Tension-Free Repair.

The aim of this study is to compare between preperitoneal approach and Lichtenstein's mesh repair in inguinal hernia repair as regard:

- Operative time.
- Length of hospital stay.
- Post-operative pain.
- Return to normal life activity.
- Recurrence rate.



Fig. (1): Dissection of the peritoneal space and identification of anatomical landmarks.



Fig. (2): Placement of the preperitoneal mesh over the whole myopectineal orifice.



Fig. (3): Fixation of preperitoneal mesh by tuckers to cover the whole myopectineal orifice.

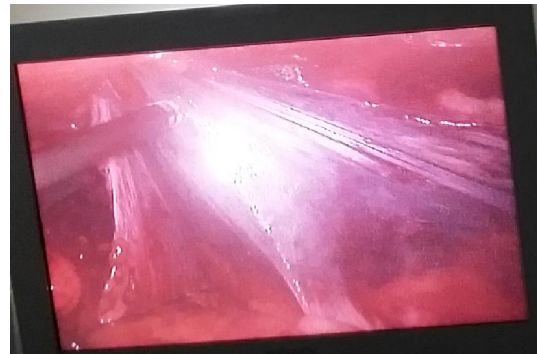


Fig. (4): approximation of peritoneal flaps to cover the preperitoneal mesh.

Open trans inguinal approach:

It includes the same steps of dissection of the sac of inguinal hernia then high ligation of sac.

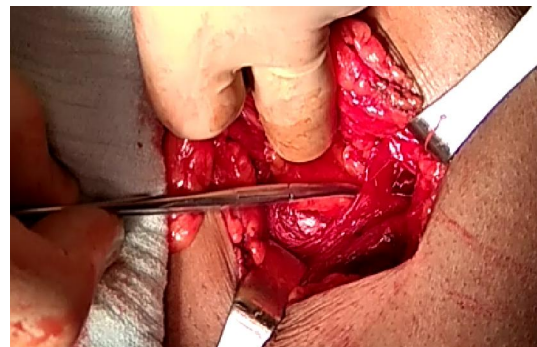


Fig. (5): Opening of fascia transversalis to reach preperitoneal space.

Postoperative management and follow-up

Single dose of antibiotic was prescribed for all patients post-operatively. Patients were permitted to return to home 24 to 72hrs after completion of the operation. Essentially no inguinal discomfort is reported. No enforced period of inactivity is required. Patients are asked to return for follow-up about one week after their surgery.

Parameters assessed

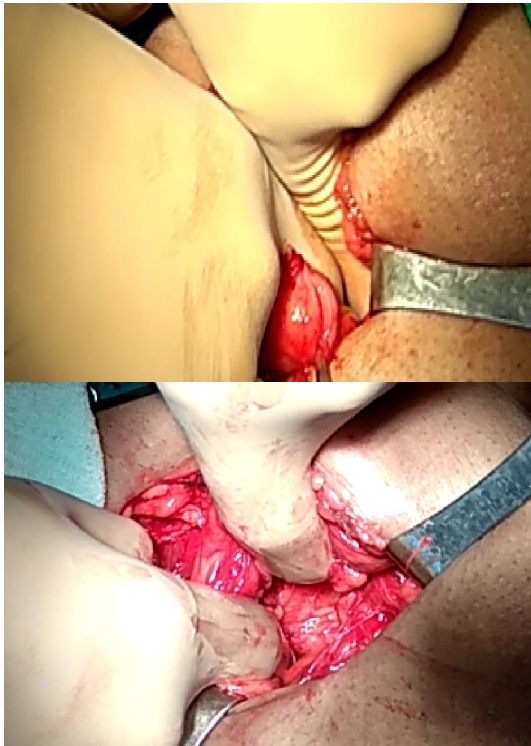


Fig. (6): Blunt dissection of preperitoneal space by index fingers.

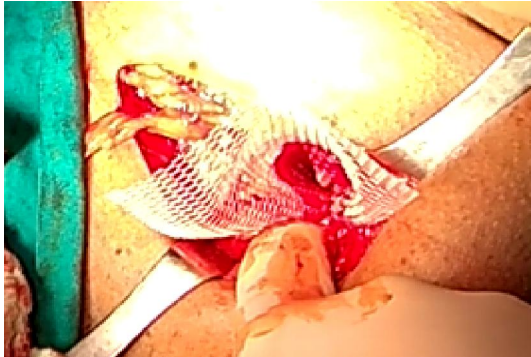


Fig. (7): Placement of preperitoneal mesh in preperitoneal space.

Certain parameters were assessed during the operative, postoperative and follow-up periods for evaluating the procedure and its consequences and benefits including:

Intraoperative parameters:

- Intra-operative time. (In minutes) is calculated from the skin incision till closure of the wounds for open cases and from insufflation of peritoneum till closure of wound in case of laparoscopic cases.

There are few pictures of intra operative steps of the preperitoneal approach (laparoscopic and open) in our study.

Laparoscopic trans abdominal preperitoneal repair (TAPP):

Postoperative parameters:

- 1) Recurrence rate.
- 2) Analgesic intake.
- 3) Nerve entrapment.
- 4) Wound infection.
- 5) Length of stay.

Follow up at 1 week, 1 month, 3 month and 6 month.

Inclusion criteria:

All elective inguinal hernia patient that are fit for the surgery

Exclusion criteria:

Patients of complicated inguinal hernia or with systemic cardiac or chest disease.

Statistical Analysis

The data were coded, entered and processed on computer using *SPSS* (version 18). The results were represented in tabular and diagrammatic forms then interpreted.

Mean, standard deviation, range, frequency, and percentage were use as descriptive statistics.

The following test was done:

- **Chi-Square test X^2** was used to test the association variables for categorical data.

- **Student's t-test** was used to assess the statistical significance of the difference between two population means in a study involving independent samples.

P value was considered significant as the following:

- * $P > 0.05$: Non significant.
- * $P \leq 0.05$: Significant (*Levesque, 2007*).

3. Results

Table (1): Comparison between group A and group B regarding sex

| | | | Group A NO. (25) | Group B NO. (25) | X^2 | P. value |
|-----|------|-----|---------------------|---------------------|-------|----------|
| Sex | Male | No. | 25 | 25 | 0 | 1 |
| | | % | 100.0% | 100.0% | | |

There was no statistically significant difference between group A and group B regarding sex.

In this study 50 hernial defects have been closed by Lichtenstein's mesh repair and preperitoneal mesh repair. Patients were followed up by routine clinical examination for 6 months.

The data of this study include the following items and results:

- **Sex**

All patients were males. Table (2) showed that group I in male (50 %) and male in group II (50 %) of sex.

- **Age:**

First of all, comparison between both groups regarding age of the patients was performed. Mean age for group I and group II were (36.73) and (34.8) years respectively.

Independent t test was performed to detect the level of significance between both groups regarding patient's age which demonstrated that there was insignificant difference between both groups (P-value > 0.05) regarding patient's age (no bias), as listed in table (3) and showed in figure (31).

Table (2): Comparison between group A and group B regarding age

| | | Group A NO. (25) | Group B NO. (25) | t.test | P. value |
|-----|---------|---------------------|---------------------|--------|----------|
| Age | Range | 29-56 | 34-56 | .71 | 0.48 |
| | Mean±SD | .367+44.28 | 45.72±6.67 | | |

There was no statistically significant difference between group A and group B regarding age.

- **Operative time:**

Comparison between both groups regarding operation time of the patients was performed. Mean operation time for group A and group B were (40) and (44) minutes respectively.

Independent t test was performed to detect the level of significance between both groups regarding operation time which demonstrated that there was insignificant difference between both groups (P value < 0.05). Although operative time was less in group A than group B but it was statistically insignificant.

Table (3): Comparison between group A and group B regarding operative time

| | | Group A NO. (25) | Group B NO. (25) | t.test | P. value |
|----------------|---------|---------------------|---------------------|--------|----------|
| Operative time | Range | 25-60 | 30-59 | -1.580 | .121 |
| | Mean±SD | 40.68±8.300 | 44.16±7.238 | | |

There was no statistically significant difference between group A and group B regarding operative time.

- **Hospital stay:**

Comparison between both groups regarding hospital stay of the patients was performed. Mean hospital stay time for group A and group B were (23.6) and (30.6) hours respectively.

Independent t test was performed to detect the level of significance between both groups regarding hospital stay time which demonstrated that there was significant difference statistically between both groups (P-value < 0.05) regarding hospital stay as listed in table (5) and showed in figure (33).

Table (4): Comparison between group A and group B regarding hospital stay

| | | Group A NO. (25) | Group B NO. (25) | t.test | P. value |
|---------------|---------|---------------------|---------------------|--------|----------|
| Hospital stay | Range | 10-38 | 10-72 | -2.612 | .012 |
| | Mean±SD | 23.60±7.077 | 30.64±11.471 | | |

There was statistically significant difference between group A and group B regarding hospital stay.

- **Post-operative complications:**

Comparison between both groups regarding postoperative complications of the patients was performed. Post-operative complications that documented in our study were post-operative pain, recurrence, wound seroma, testicular swelling.

Chi square test was performed to detect the level of significance between both groups regarding Post-operative complications.

- **Recurrence:**

There were no cases of recurrence in both groups with no statistical significance between both the groups.

Table (5): Comparison between group A and group B regarding recurrence

| | | | Group A NO. (25) | Group B NO. (25) | X ² | P. value |
|------------|----|-----|---------------------|---------------------|----------------|----------|
| Recurrence | No | No. | 25 | 25 | 0 | 1 |
| | | % | 100.0% | 100.0% | | |

There was no statistically significant difference between group A and group B regarding recurrence.

• **Post-operative pain:**

There was less cases complaining of persisting post operative pain in group A (3 cases- 12%) in comparison with group B (9 cases-36%).

Chi square test was performed to detect the level of significance between both groups regarding post operative pain which demonstrated that There was significant statistical difference P value >0.05 for group A.

Table (6): Comparison between group A and group B regarding postoperative pain

| | | | Group A NO. (25) | Group B NO. (25) | X ² | P. value |
|--------------------|---------|-----|---------------------|---------------------|----------------|----------|
| Postoperative pain | Present | No. | 3 | 9 | 3.96 | .04 |
| | | % | 12.0% | 36.0% | | |
| | Absent | No. | 22 | 16 | | |
| | | % | 88.0% | 64.0% | | |

There was statistically significant difference between group A and group B regarding postoperative pain.

• **Wound seroma:**

There were only 3 cases of wound seroma in group B with no cases of wound seroma in group A.

Chi square test was performed to detect the level of significance between both groups regarding wound seroma which demonstrated that there was no significant statistical difference between the two groups with (P value <0.05).

Table (7): Comparison between group A and group B regarding wound seroma

| | | | Group A NO. (25) | Group B NO. (25) | X ² | P. value |
|--------------|---------|-----|---------------------|---------------------|----------------|----------|
| Wound seroma | Present | No. | 0 | 3 | 3.19 | .07 |
| | | % | .0% | 12.0% | | |
| | Absent | No. | 25 | 22 | | |
| | | % | 100.0% | 88.0% | | |

There was no statistically significant difference between group A and group B regarding wound seroma.

4. Discussion

Since the introduction of open tension-free hernioplasty, presented by Lichtenstein in 1984, there was a significant reduction in recurrence after inguinal hernia repair. It has become the most popular technique for repairing inguinal hernia because of its effectiveness and simplicity. The Lichtenstein technique is one of the popular methods of inguinal hernioplasty as it is easy to learn and perform, and gives consistent good results with less than 1% recurrence rates (*Lichtenstein et al., 1989*).

The preperitoneal approach to inguinal hernia repair has grown considerably in popularity since Nyhus and colleagues reported their first series in 1959. With the development and maturity of laparoscopic technique, the anatomy as viewed from the posterior aspect has been more clearly defined and more widely understood. The preperitoneal approach, open or laparoscopic has clear advantages in the treatment of recurrent hernias, this access is free of scar tissue, which effectively prevents or reduces the risk of damage to potential groin hernia sites. An

extensive preperitoneal dissection allows the use of a large mesh covering the entire myopectineal orifice (*Eker et al., 2012*).

Chronic pain and wound complaints delays recovery and can significantly affect a patient's daily lifestyle. All these complications are avoided by placing the mesh in the preperitoneal plane. In addition, by placing a mesh in the preperitoneal space, the myopectineal orifice is covered completely which not only is the optimal treatment for indirect, direct, femoral and obturator hernias but also protects against any of these hernias from recurrence. Patients in the Licht group also had delayed return to work. This was mostly due to the chronic wound related problems. The transinguinalpreperitoneal technique can be considered more analogous to the totally extra peritoneal repair. But compared to the totally extra peritoneal repair this technique is not expensive, easier to perform and can be performed under regional anaesthesia. It can be applied to all types of primary inguinal hernia (*Ray et al., 2014*).

The laparoscopic approach to groin hernias gains access to the preperitoneal space without the associated pain and morbidity of a larger incision, and it potentially allows for a more rapid recovery with more cosmesis. The ability to repair unilateral, bilateral, or recurrent defects through 3 small cosmetic incisions (10, 5, and 5 mm, respectively); with early return to normal activities makes TAP an attractive surgical option (*Pullyblank et al., 2002*).

Jaime et al stated that tension-free permanent mesh covers all 3 groin hernia sites in a minimally invasive fashion with every move done under full visualization is the principles of the laparoscopic approach (*Jaime et al., 2003*).

A total of 302 patients were randomized to TIPP (143) or Lichtenstein (159) repair. Baseline characteristics were comparable in the two groups. Significantly fewer patients in the TIPP group had continuous chronic pain 1 year after surgery: five patients (3.5 per cent) versus 20 patients (12.9 per cent) in the Lichtenstein group ($P = 0.004$). An additional 12 patients (8.5 per cent) in the TIPP group and 60 (38.7 per cent) in the Lichtenstein group experienced pain during activity ($P = 0.001$). There were two patients with recurrence in the TIPP group and four in the Lichtenstein group, but no significant differences were found in other severe adverse events between the groups (*Koning et al., 2012*).

Analysis of reported data shows that TAPP has less postoperative pain and early return to work than Lichtenstein method. Operation time is shown to be longer in the TAPP but this difference is shortened with increasing surgeon experience. The meta-analysis of the data on complications shows that there are no significant differences between the two types of

procedures. TAPP causes more short-term recurrences which are attributed to the learning curve effect. Long-term recurrence rates on the other hand show no significant differences (*Myers et al., 2010*).

For the management of unilateral hernias, the base-case analysis and most of the sensitivity analysis suggest that open flat mesh is the least costly option but provides less quality adjusted life years (QALYs) than TAPP. It is likely that, for management of symptomatic bilateral hernias, laparoscopic repair would be more cost-effective. When possible repair of contralateral occult hernias is taken into account, TAPP repair is most likely to be considered cost-effective at threshold values for the cost per additional QALY. The increased adoption of laparoscopic techniques may allow patients to return to usual activities faster. This may, for some people, reduce any loss of income (*Akolekar et al., 2008*).

In terms of complications and short-term recurrence, TAP repair is comparable with open repair. Moreover, TAP is significantly less painful in the early postoperative period, leading to earlier ambulation than open repair. Additionally, TAP results in significantly earlier return to work and better cosmetic results. Currently, TAP seems to be a better alternative than the existing open repair, provided the long-term recurrence rates are comparable (*Singh, 2009*).

Operating times of surgical techniques varies between surgeons and also vary considerably between centers. It reduces with experience. It is less important to the patient than successful operation. The operative time to perform unilateral primary inguinal hernia has frequently been reported as longer for laparoscopic compared to open repair, however the mean difference is 12.81 minutes this difference disappears in bilateral and recurrent cases (*Bisgaard et al., 2007*).

The postoperative pain is an important issue to the patient as it results in usage of many and even large dose analgesia that it will increase the cost and morbidity. The laparoscopic technique have a superior advantage in the postoperative pain and less administration of analgesia with p value >0.0018 and >0.007 in the 1st 24hrs and 1st week postoperative. Finally it will improve the quality of life in the post-operative period (*Thompson et al., 2008*).

The recurrence rate is the most important factor in the assessment of any procedure. In the laparoscopic inguinal hernia repair the recurrence rate will decrease as the surgeon experience increase, some studies demonstrate that before 250 repairs the recurrence rate of the surgeon will be more than 10% and after that number the recurrence rate will be less than 10%. Other studies did not see that fixed number

and it differ from one surgeon to another (*Thompson et al., 2008*).

The mean postoperative hospital stay in lap. versus open is 21.3+4.1hrs versus 26.6+81hrs (*Thompson et al., 2008*).

Myers et al., (2010) stated that, there is not a significant difference in recurrence rates between laparoscopic and open repair. Interestingly, there was a lower recurrence rate in the laparoscopic repair for recurrent hernias. A Cochrane review on laparoscopic versus open inguinal hernia repairs identified 41 published reports of eligible trials involving 7161 participants. Sample sizes ranged from 38 to 994, with follow-up of 6 weeks to 36 months.

Length of hospital stay did not differ between groups, but return to usual activity was earlier for laparoscopic groups. The data available showed less persisting pain (290/2101 versus 459/2399) and less persisting numbness (102/1419 versus 217/1624) in the laparoscopic groups. In total, 86 recurrences were reported among 3138 allocated laparoscopic repair and 109 among 3504 allocated to open repair (*Eklund et al., 2010*).

In our study included 50 adult patients with inguinal hernias (Nyhus type I, II, IIIA). The patients were randomly divided into two equal groups 25 patients each, to be treated by the preperitoneal approach which includes transabdominal preperitoneal laparoscopic inguinal hernioplasty & open trans inguinal preperitoneal approach versus Lichtenstein Tension-Free Repair. The patients were followed up for a period of 1, 3, 6 months. We compared both procedures in different aspects as regard the operative time, the occurrence of postoperative pain, hospital stay in hours from the time of operation till the time of discharge, postoperative complications (including postoperative seroma formation, testicular swelling, pain, infection and recurrence rates.

As regard operative time there was no significant difference between both techniques with a mean operative time 40.6 minutes for the preperitoneal approach group and 44.2 minutes for the open Lichtenstein group, thus it is shown that there is around 4 minutes, that was proved to be statistically insignificant when proved by the P-value which was <0.05.

The post-operative hospital stay in the preperitoneal group was statistically significantly less in the open Lichtenstein's group, where the mean hospital stay in hours for the group A was significantly lower than the group B (23.6 versus 30.6 hours). This parameter is evident in the 1st 24 hours discharged patients with a P-value < 0.05 (statistically significant) thus the preperitoneal approach is shown to have an extra economic value in minimizing the overall costs.

Regarding post-operative complications we have 3 cases of wound seroma and 3 cases in testicular swelling resolved within a week from surgery in the open Lichtenstein's group while in the preperitoneal group there is no cases of wound seroma with no significant difference as detected from (P-value <0.05). As we see in the era of minimally invasive surgery there is less wound complications and less morbidity.

Regarding post operative pain in our study the preperitoneal group show less persisting postoperative pain levels was compared with open lichtenstein group; it was shown to be statistically significant in the preperitoneal group with P-value < 0.05 (significant) so less hospital stay, earlier return to normal activity and less postoperative analgesia to control pain and thus the preperitoneal approach has shown to have a significant effect in one of the most annoying postoperative parameters for the patients that is the postoperative pain. In this study no reported cases of hernia recurrence.

Table (8): Comparative data

| Source | Number of Preperitoneal vs Lichtenstein | Intervention | Findings |
|------------------------|---|----------------------|--|
| Bahram MAL, 2017 | 150 vs 150 | TAPP vs Lichtenstein | Shorter operative time Less post-operative pain Less hospital stay |
| Benedetto et al., 2016 | 47 vs 69 | TAPP vs Lichtenstein | Less early postoperative pain, shorter hospital stay, Less post-operative complications |
| Ray et al., 2014 | 35 vs 34 | TIPP vs lichtenstein | Similar recurrence rate Less immediate post op pain |
| Sajid et al., 2013 | Meta-analysis 714 vs 723 | TIPP vs lichtenstein | Less chronic groin pain Similar recurrence rate |
| Koning et al., 2012 | 143 vs 159 | TIPP vs lichtenstein | Less recurrence rate Less post-operative pain |
| Douek et al., 2003 | 122 vs 120 | TAPP vs Lichtenstein | Earlier return to work Less postop pain, Less frequent paresthesia Less recurrence rate |

Various mechanisms of hernia recurrence have been suggested. **Deans et al.** suggested that medial recurrences might occur owing to the rolling away of the mesh from the pubic ramus to expose the Hesselbach's triangle. **Fiennes and Taylor** stated that desufflation after laparoscopic hernioplasty tends to elevate the lower edge of the mesh and predisposes to migration of the inferomedial aspect from the space of Retzius in the presence of a direct defect (**Taylor et al., 2008**).

The two most common causes of recurrence are incomplete dissection of the myopectineal orifice and inadequate size of the mesh. **Lowham et al.** reviewed 13 videotapes of hernias that had recurred in the multicenter trial by **Fitzgibbons et al.** and found that incomplete dissection of the myopectineal orifice was the primary cause of recurrence. There were other causes also, but in many cases they were secondary to inadequate dissection (**Tamme et al., 2003**).

Conclusion

From this study we can conclude:

- The preperitoneal approach either laparoscopic or open inguinal hernia repair is better than Lichtenstein's repair because of less postoperative discomfort and pain, reduced recovery time that allows earlier return to full activity, easier repair of a recurrent hernia, the ability to treat bilateral hernias concurrently, ligation of the hernia sac at the highest possible site, allows the surgeon to cover all potential defect with one piece of mesh, improved cosmesis and in case of laparoscopy performing a simultaneous diagnostic laparoscopy.

- Based on our prospective randomized study, a few conclusions can be made. There was lower rates of postoperative pain and hospital stay. Operative time decreases with the surgeon's experience. Also Postoperative recovery is short also had less incidence of wound induration and chronic groin pain. So that we recommend the preperitoneal approach in the inguinal hernia repair as an alternative to traditional Lichtenstein's method.

References

1. Amid PK (2004): Lichtenstein tension-free hernioplasty: its conception, evolution and principles. *Hernia* 8:1-7.
2. Cuschieri A, Seymour N, Bell R, et al. (2015): Disorders of Anterior Abdominal Wall, Omentum, Mesentery, and Retroperitoneum: Epidemiology of hernias, p497.
3. Greenberg A & Brooks DC (2013): Hernias in Maingot's abdominal operations, The Pre-Peritoneal Approach, 12th ED, p132.
4. Patrick J, Greenberg A, Brooks D, et al. (2013): Hernias in Maingot's abdominal operations 12th ED, P.124.
5. Skandalakis JE & Smith CD (2014): Mechanical benefits of placing mesh behind defect (preperitoneal) to resist intra-abdominal forces promoting herniation. 4th (ED). P.194-196.
6. Akolekar D, Kumar S, Khan LR, et al. (2008): Comparison of recurrence with lightweight composite polypropylene mesh and heavyweight mesh in laparoscopic transabdominal preperitoneal inguinal hernia repair: an audit of 1,232 repairs. *Hernia* 12:39-43.
7. Bahram MAL (2017): Early and late outcomes of trans-abdominal pre-peritoneal and Lichtenstein repair for inguinal hernia, a comparative study. *IntSurg J, Bahram MAL. IntSurg J*; 4(2):459-64.
8. Benedetto I, Duran H, Eduardo D, et al. (2016): A Randomized Clinical Trial of Laparoscopic Trans-Abdominal Preperitoneal (TAPP) vs Open Lichtenstein Repair for Bilateral Inguinal Hernias, ISSN 1072-7515/16.
9. Bisgaard T, Bay-Nielsen M, Christensen IJ, et al. (2007): Risk of recurrence 5 years or more after primary Lichtenstein mesh and sutured inguinal hernia repair. *Br J Surg*. 94: 1038-40.
10. Douek M, Smith G, Oshowo A, et al (2003): prospective randomized controlled trial of laparoscopic versus open inguinal hernia mesh repair: five year follow up. *BMJ*.2003.Doi:10.1136/bmj.326.7397.1012.
11. Eker H, Langeveld HR, Klitsie PJ, et al. (2012): Randomized clinical trial of total extraperitoneal inguinal hernioplasty vs Lichtenstein repair: a long-term follow-up study. *PubMed*; DOI: 10.1001/archsurg.2011.2023.
12. Eklund A, Montgomery A, Bergkvist L, et al. (2010): Chronic pain 5 years after randomized comparison of laparoscopic and Lichtenstein inguinal hernia repair. *Br J Surg*; 97:600-608.
13. Eubanks S (2011): Hernias in Text Book of Surgery. The Biological Basis Modern Surgical Practice, edited by David C. Sabiston J. R., H. Kim Lyerly W.B., published by Saunders Company a division of Harcourt Brace and Company, fifteenth edition, Chapter 37.p.1219-1224.
14. Jaime H, Kendrick M, Tobias M, et al. (2003): Totallyextra peritoneal (TEP) approach for inguinal hernia: the favorable learning curve for trainees.Doi.org/10.1016/S0149-7944(02)00657-8.
15. Koning G, Keus F, Cheung LC, et al. (2012): Randomized clinical trial of chronic pain after the transinguinalpreperitoneal technique compared with Lichtenstein's method for

- inguinal hernia repair, *British Journal of Surgery*; 99: 1365–1373.
16. Levesque R (2007). *SPSS Programming and Data Management: A Guide for SPSS and SAS Users*, SPSS Inc. Chicago Ill. PDF ISBN, 1-56827-390-8.
 17. Lichtenstein L, Alex G, Amid PK et al (1989): The Tension-Free Hernioplasty. *Am J Surg* 1989; 157: 188.
 18. Myers E, Browne KM, Kavanagh DO, et al. (2010): Laparoscopic (TEP) versus Lichtenstein inguinal hernia repair: a comparison of quality-of-life outcomes. *World J Surg* 34:3059–3064.
 19. Pullyblank, carney L, Dixon AR, et al. (2002): Laparoscopic inguinal hernia: a NICE operation. *J R Coll Surg Edinb.* 47(4):630-3.
 20. Ray R, Manoranjan K and Mukhopadhyay M (2014): Transinguinal Preperitoneal Technique of Inguinal Hernioplasty – A Better Alternative to Lichtenstein Procedure, *Journal of Clinical and Diagnostic Research*, 8(5): NC01-NC03.
 21. Sajid MS, Kalra L, Paramalli U, et al. (2013): A systematic review and meta-analysis evaluating the effectiveness of lightweight mesh against heavyweight mesh in influencing the incidence of chronic groin pain following laparoscopic inguinal hernia repair. *Br J Surg*; 91(3):3627.
 22. Sajid MS, Singh KK, Baig MK, et al. (2013): Open transinguinalpreperitoneal mesh repair of inguinal hernia: a targeted systematic review and meta-analysis of published randomized controlled trials, 127–137.
 23. Tamme C, Garde N, Klingler A, et al. (2005): Totally extraperitoneal inguinal hernioplasty with titanium- coated lightweight polypropylene mesh: early results. *SurgEndosc* 19: 1125- 1129.
 24. Tamme C, Scheidbach H, Hampe C, et al, (2003): Totally extraperitoneal endoscopic inguinal hernia repair (TEP) *SurgEndosc* 17: 190-195.
 25. Taylor C, Layani L, Liew V, et al (2008): Laparoscopic inguinal hernia repair without mesh fixation, early results of a large randomized clinical trial. *Surg Endosc* 22:757. [PMID: 17885789].
 26. Thompson JS, Gibbs JO, Reda DJ, et al. (2008): Does delaying repair of an asymptomatic hernia have a penalty? *Am J Surg* 195(1):89–93.

8/13/2018