



## MINIMAL INVASIVE SURGERY IN INGUINAL HERNIA REPAIR: A REVIEW

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### ABSTRACT

Inguinal hernia is the most common hernia which comprises around 75% of all abdominal hernia detected in groin region. It is a frequent surgery performed annually over 20 million patients around the world. Recently conventional laparoscopic repairing is being more popular technique to perform hernia surgery and scrutinize through many published related articles resulting better post-operative outcomes than the open inguinal hernia repairing. Another recently introduced LESS technique which is the extended form of conventional laparoscopic TEP surgery and still safe and efficient technique but encounter with certain difficulties and work limitation.

**Objective:** The main objective of this study is to review and scrutinize literatures through electronic database to compare between minimal invasive surgery with open surgery in case of intra-operative and post-operative complications.

**Methodology:** Multiple literatures have been searched through electronic database including PubMed, PMC database, JAMA, Cochrane and Google scholar related to the topic and data was collected published articles from 1995 to 2018 to study and analyze feasibility, safety, efficiency between minimal invasive laparoscopic surgery over open repair.

**Conclusions:** Conventional laparoscopic inguinal hernia repairing is better technique than open repairing regarding safety, feasibility and efficiency but in case of LESS technique it has to be done more research and discussion to come into conclusion.

**Keywords:** Inguinal hernia, Mesh Repair, Laparoscopy, TAPP, TEP, LESS

TAPP: Trans-abdominal pre-peritoneal

TEP: Totally extra-peritoneal

LESS: Laparo-endoscopic single site

## INTRODUCTION

Hernia is defined as the protrusion of abdominal contents through the weakness of cavity wall (eg. bowel, mesentery etc.). The term hernia came from the Latin word which means "Rupture" through the wall of abdomen, and with the age advances the wall of abdominal muscles become weak and hernia can occur. Hernia can occur in various form occasionally abdominal and groin hernia such as hiatal hernia, incisional hernia, Umbilical hernia, femoral hernia and inguinal hernia. "Tadaki et al stated that all hernia of abdominal wall detected in the groin region are term as "inguinal", which comprises approximately 75% of hernias".<sup>[1]</sup>

Worldwide, inguinal hernia repairing is the most frequent surgery performed over 20 million people annually.<sup>[2,7]</sup> It is the most common groin hernia that comes out during straining, coughing and standing up but occasionally reduces back in supine. In case of male patient inguinal hernia contents spermatic cord whereas round ligament in female and it is frequently seen in right side than left and due to the anatomical structure. It is higher in male than in female approximately 27% in male and 3% in Female.<sup>[3]</sup>

There are two types of inguinal hernia on the basis of inferior epigastric vessel. Direct inguinal hernia occurs at the middle of inferior epigastric vessel through the weakness of transversalis fascia of the posterior wall in the Hasselbach's triangle. Indirect inguinal hernia occurs lateral to the inferior epigastric vessel through the deep inguinal hernia.

In the past, there had been different modalities of surgery for repairing inguinal hernia; attempting first to solve the inguinal hernia in 16th century by the very famous Italian anatomist Gabriele Fallopio and he formulated wide excision to the hernia sac and whole contents of it with surrounding skin with suture. This technique has risk of bleeding and the peritonitis so that it was not accepted widely during that time.<sup>[4,5]</sup> In the 17<sup>th</sup> century one of the very popular Spanish anatomist and surgeon Antonio Gimbernat Y Arbos developed a technique for the incarcerated inguinal hernia.<sup>[4,5]</sup>

Later, on the 19<sup>th</sup> century as rapid evolution in medicine and surgery many research had been done to formulate the new ideas and techniques for the management of inguinal hernia repair. They had developed the antiseptic, asepsis and anesthesia which help the surgical procedure to be more safe and efficient. Edoardo Bassini on 1887 had overcome with the new way of management for the radical cure of the inguinal hernia with the reconstruction of the inguinal canal and William Steward Halsted on 1887 modified the Edoardo bassini procedure by transfixing the posterior wall, localizing the spermatic cord and positions it into the subcutaneous tissues. It was also again further modified by Paolo Postempski on 1890 with the closure of the external inguinal ring. Edward Earl Shouldice 1953, proposed new technique to repair the inguinal hernia with incision and reconstruction of transverse fascia with suture materials. Francis Usher 1959, he just modified the bassini repairing by reinforcing with synthetic mesh and the Irrin Lichtenstein 1984, developed another very important method "Lichtenstein procedure" in which the posterior wall of the inguinal canal is reinforced with synthetic mesh. This procedure became so popular and in many parts of the world still surgeons are following this procedure.<sup>[4,5]</sup>

Recently, Laparoscopic procedure has been widely used by many experience surgeons and has become very popular. Laparoscopic procedure is the minimally invasive surgery and it has various advantages as compare with the open inguinal hernia repairing. Laparoscopic and endoscopic technique, TAPP and TEP are the minimally invasive multiport system described in 1993. [5,6] Laparo-endoscopic procedure is usually done with three port system one 10mm port, on sub-umbilical region and two 5mm port on both lateral side right below the umbilical region in midclavicular line. In TAPP laparoscopic technique after incision of the peritoneum synthetic mesh is placed into the pre-peritoneal space where as in conventional total extra-peritoneal (CTEP) laparo-endoscopic technique peritoneum separated and space created for Co2 gas insufflation after that synthetic mesh is fixed in the pre-peritoneal space.[5,6] Different research finally concluded that laparo-endoscopic surgery in inguinal hernia repairing has several benefits in terms of post-operative pain, duration of hospital stay, intraoperative bleeding, hernia recurrence rate and the cosmetic purpose than open inguinal hernia repairing. Currently, conventional laparoscopic procedure for inguinal hernia repairing has been more extended into LESS incision and many surgeons from different centers following this approach. LESS surgery has obviously reduced the incision site, cosmetically accepted but still more research is going on in case of post-operative pain, recurrence rate of hernia, wound infection, hematoma and seroma. Single port laparoscopic surgery has been done with different names in different centers throughout the world such as LESS, Single incision laparoscopic surgery (SILS), Single port access surgery (SPA), One port umbilical surgery (OPUS) and Trans-umbilical endoscopic surgery (TUES). Recently, in 2014 from different hernia society European hernia society (EHS), the international Endo-hernia society (IEHS) and the European association for endoscopic surgery (EAES) has brought a guideline to upgrade surgical technique for inguinal hernia repairing by the Hernia surge group which involves member from all the continents of hernia society. [7,8]

## METHODOLOGY

In order to gain knowledge and utilizing the recently developed minimal invasive laparoscopic TEP and trans-abdominal pre-peritoneal approach in the inguinal hernia repairing has been applied and thoroughly analyzed the feasibility, safety and the efficiency of procedure. The outcomes of risk of in intra-operative and post-operative were studied from different literatures review. After that, another LESS surgery the extended form of laparoscopic multiport system introduces to analyzed the advantages and the limitation of the procedure. Gerrish and Lacey stated, literature review helps to gain different knowledge, analyzed and come into conclusion.

The search has been done through the electronic database from various online sites, PubMed PMC, JAMA, Wikipedia and various books. The data was extracted from different published articles which are related to the topics that helps the researcher to enables meaningful discussion and analyzed their collective opinion. These data were extracted from 1995 to 2018, which includes the name of author, year of publication, country which they belong, Age and sex of the patients. I have gone through many papers but collected data and

information, analyzing them from few articles in my literature review. These reviews help the researcher to achieved their critical opinion, meaningful discussion and appropriate results but Parahoo state that more advance and extended knowledge can be provided through books and guidelines.



**Figure 1:** LESS Technique



**Figure 2:** Conventional Laparoscopy



**Figure 3:** Incision for LESS



**Figure 4:** Open inguinal hernia repairing

### **Criteria for the patients Selections:**

The main purpose of the patient selections criteria is to keep our study within the limitation of articles review. So the inclusion criteria are as follows: [15,23]

- 1) The patients with primary inguinal hernia, Unilateral/ Bilateral inguinal hernia
- 2) Patients >18 years (Both Male and Female)
- 3) Patients that meet the criteria to undergo into discussion for outcomes and complications such as post-operative pain, post- operative hospital stay, recurrence rate, Hematoma, seroma and intra-operative blood loss.

**Exclusion Criteria:** [15,23]

- 1) Patients age less than 18 Years.
- 2) Patients are not fit for general anesthesia.
- 3) Patients with incarcerated hernia, Prior history of abdominal surgery, Post irradiation conditions, Coagulation disorder etc.

Many different articles were scrutinized through the electronic database and among them the data was collected from few published articles which is closely related to the topics for review and analyze outcome.

| Reference                                   | Year (Publication) | No.of Pts | Laparoscopic repair(inguinal hernia) | Open inguinal hernia repairing | p- value |
|---|--------------------|-----------|--------------------------------------|--------------------------------|----------|
| Aitola et al                                | 2015               | 49        | 24                                   | 25                             |          |
| Operating time                              | -                  | -         | 66+/_14.3                            | 55+/_14.3                      |          |
| Recurrence Rate                             | -                  | -         | 3                                    | 2                              |          |
| Chronic pain                                | -                  | -         | 0                                    | 0                              |          |
|   | -                  | -         | 5                                    | 2                              |          |
| Complication                                | -                  | -         | Not reported                         | Not reported                   |          |
| Peri-operative pain(30 days)                |                    |           |                                      |                                |          |
| L.Timisescu et al (Post-operative Outcomes) | 2013               | 325       | 234                                  | 91                             |          |
| Haematoma                                   | -                  | -         | 2 (0.9%)                             | 9 (9.9%)                       |          |
| Infection                                   | -                  | -         | 0                                    | 5 (5.5%)                       |          |
| Recurrence                                  | -                  | -         | 1 (0.4%)                             | 5 (1.09%)                      |          |
| Hasan H. Eker et al                         | 2012               | 660       | 336                                  | 324                            |          |
| Hernia recurrence rate                      | -                  | -         | 4.9%(12 of 247)                      | 8.1%(19of 235)                 | P=0.10   |
| Chronic pain                                | -                  | -         | 14.9%                                | 28%                            | P=0.004  |

|   |      |    |                        |                |         |
|---|------|----|------------------------|----------------|---------|
| Patients Satisfaction                                 | -    | -  | 8.5 points(10)         | 8.0 points(10) | P=0.004 |
| Leandro Mendonca Pedroso et al                        | 2017 | 60 | 30                     | 30             |         |
| Post-operative complication                           | -    | -  | 6 (8.3%)               | 26 (92.9%)     | <0.001  |
| Edema occurrence                                      | -    | -  | 14 (50%)               | 20 (71.4%)     | <0.001  |
| Analgesic Administration                              | -    | -  | 0                      | 0              |         |
| Recurrence rate (at 12 months)                        | -    | -  | 1 (3.6%)               | 9 (32.1%)      | <0.003  |
| Chronic Pain  |      |    |                        |                |         |
| Hanh Tran et al                                       | 2011 | 68 | SILS-TEP (12 pts)      | -              |         |
| Median operating time (unilateral 9 pts) /Bilateral 3 | -    | -  | 65 minutes/110 minutes | -              |         |
| Conversion Rate                                       | -    | -  | 1 (3-port TEP)         | -              |         |
| Recurrence Rate (1 and 10 months)                     | -    | -  | 0                      | -              |         |

**Table 1**

**DISCUSSION**

Since the minimal invasive surgery is being widely used technique by highly experience surgeons, this has recently become more popular in many centers. Therefore, lots of research have been done and discuss about the advantages and limitation of laparoscopic surgery. The extracted data from the various published articles includes both adult male and female with unilateral/ bilateral primary inguinal hernia. The number of patients was randomly classified into laparoscopic and open inguinal hernia repairing group and comparative study for post-operative complication, wound infection, operating time, recurrence of hernia and their limitation was discussing. Usually the laparoscopic repair of inguinal hernia is done in general anesthesia whereas open inguinal hernia repairing (Lichtenstein procedure) is done in local anesthesia. Aitola et al stated that the operating time taken in conventional laparoscopic technique was 66+/\_14.3 whereas 55+/\_14.3 in

open Lichtenstein technique which is significantly higher in laparoscopic repair and the recurrence rate of hernia is also higher but there is no record of chronic pain in follow up. Based on research the operating time and the hernia recurrence rate is usually depending on the level of surgeon, technique and the prosthetic mesh that is used during inguinal hernia repair. So, the post-operative complication, rate of hernia recurrence can have reduced with adjustment of larger size of synthetic mesh (10x15cm) in pre-peritoneal space as well as expert and proper technique by surgeons.

L. Timiseu et al includes the study between laparoscopic repair and open Lichtenstein procedure for bilateral inguinal hernia focusing on the immediate complications and post-operative hospital stay. Usually, the complication during laparoscopic and open Lichtenstein procedure is 5% and 16% respectively. The post-operative hematoma formation after open repair is 9.9% compared to laparoscopic 0.9% which is significantly more and infection rate during open repair is around 5.5% which is still higher. Talking about recurrence of inguinal hernia 0.4% after the laparoscopic method and 1.09% after open repairing, which is statistically higher. The data shows post-operative hospital stay after minimal invasive surgery is  $2.1 \pm 1.2$  and  $4.7 \pm 2$  days with open intervention. So this explains the patients can return into normal daily activities earlier after laparoscopic repair than open. Mc Cormack et al [16] state that the risk of vascular and visceral injury is comparatively increased with endoscopic technique than open commonly seen during TAPP.

Hansan H. Eker et al shows in his study group between laparoscopic TEP surgery Versus Lichtenstein repair, the rate of conversion is 6.3% and 6.6% in laparoscopic TEP and Lichtenstein respectively. Regarding the post-operative chronic pain after the follow up at 5 years, about 14.9% of total patients treated with minimal invasive intervention and 28% in open repair has complained. Concerning about the rate of hernia recurrence and overall patient's satisfaction after the procedure has better result in laparoscopic TEP than open repair. It shows around 4.9% hernia recurrence rate in laparoscopic TEP while in open procedure 8.1%. Patients are being almost satisfied with both the procedure as the points given from 0 to 10, and 10 being the maximum satisfied. There is always higher chance of perioperative injury and post-operative complication by the residents and level 1 surgeon during endoscopic procedure, so can be minimized with very experience level 3 surgeon.

Leandro Mendonca Pedroso et al, state post-operative pain is lower in TAPP inguinal hernia repairing than lichtenstein, pain was evaluated by Visual Analogue scale (VAS) which is very easy and reliable. Post-operative pain during day 02, day 10, and day 30 was evaluated and there is no any significant difference in day 02 but on day 10 and day 30, post-operative pain was significantly low in TAPP. During post-operative period pain management was done with administration of analgesics including around 50% in TAPP and 71.4% in open repair. Also post-operative edema presents higher in open procedure approximately 92.9% as compared to TAPP (8.3%) but there is no any case of hernia recurrence at 12 months follow up. Patients were advised for follow up to evaluate chronic pain and paresthesia, among them 32.1% of Lichtenstein repair and on the other hand 3.6% with laparoscopic repair were complaining chronic pain and paresthesia.

Hanh Tran et al, performed prospective study in total 68 patients with both unilateral and bilateral inguinal hernias under single incision laparoscopy surgery (SILS-TEP) and 3-port laparoscopic totally extra-peritoneal surgery (3-port TEP). Among total 12 patients 9 unilateral, 3 bilateral inguinal hernia repairing was performed with SILS-TEP, then median operating time was recorded as 65 minutes for unilateral 110 minutes for bilateral hernia and on the other entire cohort group the median time taken was 50 minutes in unilateral and 80 minutes in bilateral applying 3-port conventional TEP which is significantly lower than SILS-TEP. There was only one case converted into conventional TEP, but no case turned into open repair. Follow up in 1 month and 10 months, the recurrence rate of hernia recorded nil. Therefore, SILS-TEP is very safe and efficient resulting better outcomes but has some limitation during operation.

### **Advantage of minimal invasive laparoscopic Surgery:**

Currently, minimal invasive laparoscopic surgery is widely performed technique and it has certain benefits while operating the patients. It helps to create small incision or port size wound due to this infection rate is minimized and very less scar formation so, it is cosmetically preferred method. Also it can reduce the post-operative hospital stay and patients can be mobilized and return to daily activities earlier. Laparoscopic surgery provides good visualization of organs and structures also reduce intra-operative blood loss.<sup>[17]</sup>

### **Disadvantage of minimal invasive laparoscopic surgery:**

Although minimal invasive technique being so popular and convenient, it has some disadvantages and limitation. Open inguinal hernia repairing does have “learning curve” but laparoscopic repair has slow “learning curve” for new technique.<sup>[16,19]</sup> So highly experience surgeon need to perform for minimizing post-operative complications. During the laparoscopic procedure there is risk of viscera perforation, neurovascular injury, hemodynamic and ventilator changes. Gas that is used to create a space during surgery may also have a risk of gas embolus.<sup>[17]</sup> It has longer operating time compared to conventional open surgery and chance of hernia recurrence on port side if performed by inexperienced surgeon. Many patients are not access to such kind of advance surgery because of unavailability in many centers and other certain limitation. It is also costlier than open procedure.

### **Limitation of Laparo-endoscopic single site surgery (LESS):**

The main idea of LESS is to carry out surgical procedure from the single incision site so as to get benefits over conventional laparoscopic technique. Performing surgery through a single site can be more difficult procedure and encounter with number of limitation. During LESS through small entry access point, there will be certain difficulties that is the instruments used are so close to each other, instruments are arranged in parallel, there will be a restriction of range of motion and the loss of triangulation.<sup>[13,20]</sup> While performing a s minimal invasive surgery through a single port, multiple instruments will be using which promote the close proximity and clashes the instruments with each other resulting a difficulty in movement. There are varieties of dissection technique while operating the patients with LESS to improve the proper technique and maintain the working space. The two most important methods are “inline” dissection, in this method one hand pulls backward and other hand pushes forward. Second important method is “vertical”



dissection where the instruments are vertically arranged in opposite direction on both side of laparoscopy. There is also another maneuver for dissection called "horizontal" dissection technique which has certain limitation of clashing of instruments while dissecting tissue structures.<sup>[13]</sup> Besides these all single site minimal invasive surgery has recorded longer operating time as compared to conventional laparoscopic TEP.

## CONCLUSION

Inguinal hernia is very common disease and performed surgery frequently, so hernia repair can be done either laparoscopic or open technique. So far minimal invasive conventional laparoscopic TEP is concerned, it is more safe and efficient technique to perform inguinal hernia repair who can tolerate general anesthesia. It has more advantages in terms of recurrence of hernia, chronic pain, hematoma formation, rate of infection and scar formation as compared to open repair. It is noted in the literatures that morbidity and post-operative complications of the patients depend on surgeon's technique and long experiences. Conventional laparoscopic procedure takes longer operating time than open repair moreover LESS requires even more than both procedures. LESS is very safe as well as efficient procedure to repair inguinal hernia but because of certain limitation and difficulties facing during operation, it is still the subject of debate that which is superior LESS or conventional laparoscopic surgery. So it is said that to have meaningful discussion, more research has to be done regarding LESS.

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