

# Laparoscopic tapp repair of inguinal hernia: different methods of mesh fixation

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## Abstract

Herniorrhaphy is one of the most commonly performed operations. Worldwide, 20 million groin hernia repairs are accomplished each year. The main outcomes of interest are operative time, complications, postoperative pain, return to activities, recurrence rates, and cost. According to Hawn and colleagues, the two most important indicators of an effective inguinal herniorrhaphy are recurrence and pain. To find out the best method of fixation of mesh in TAPP repair of inguinal hernia and the complication of each method. As well as Evaluation of the intra-operative and post-operative complications comparing between these methods. We conducted a randomized prospective study, over an 18 months period, in order to compare multiple aspects between self-fixing mesh, staples or fibrin glue for mesh fixation in laparoscopic TAPP repair of inguinal hernia from different points of view including operation duration, postoperative pain, postoperative complications, postoperative hospital stay, time needed to return to normal activity, and most importantly the recurrence. This was a prospective randomized controlled study. It included 90 adult male and female patients with inguinal hernia divided into three equal groups all patients had (TAPP), transabdominal preperitoneal hernioplasty. An increase in IO vascular injury and nerve injury, in group-I (6.7%, 3.3% respectively); compared to other groups; but not reaching statistical significance ( $p > 0.05$ ). A decrease in 1-week complications rate, in group-III (3.3%); compared to other groups (6.6%, 13.3%); but not reaching statistical significance ( $p > 0.05$ ). Non-significant difference as regards FU 3 complications (3.3% respectively) ( $p > 0.05$ ). A significant decrease in pain scores over time, in group-III (at day-0); compared to group-II (at 1 week); compared to in group-I (at 12 months), with significant statistical difference ( $p < 0.001$ ). An increase in 1-week, 3, 6, 12, and 18-month recurrence rates, in group-II (3.3%, 6.7% respectively); compared to other groups; but not reaching statistical significance ( $p > 0.05$ ). Mesh fixation using tacker fixation and fibrin glue showed better results than fixation using self-fixing mesh regarding post-operative pain and lack of recurrence, but regarding operative time and post-operative complications, there were no significant difference between the 3 methods, so we recommended that repair using tacker fixation and relatively fibrin glue should take the upper hand.

**Keywords:** Intraperitoneal onlay mesh, Transabdominal preperitoneal repair.

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## 1. Introduction

Hernia is defined as an abnormal protrusion of an organ or tissue through a defect in its surrounding walls (Courtney et al., 2012). Hernia repair is one of the most common operations performed by general surgeons. Despite Dowara et al., 2023

the frequency of this procedure, no surgeon has ideal results, and complications such as postoperative pain, nerve injury, infection, and recurrence rate (Courtney et al., 2012). The standard method for inguinal hernia repair had changed a little over a hundred years until the introduction of synthetic

mesh. This mesh can be placed by either using an open approach or by using a minimal access laparoscopic technique. There is no apparent difference in incidence of recurrence between laparoscopic and open methods of hernia repair. It was found that there is suggested less pain and numbness following laparoscopic repair. Return to usual activities is faster (McCormack *et al.*, 2003). Despite the prevalence of this disease, no universally accepted classification system exists. As a result, there is a wide spectrum of patients that develop inguinal hernias (John L., *et al.*, 2014). In 1979 laparoscopic repair of groin hernia was first reported by P. Fletcher, where he closed the neck of the hernia sac (John L., *et al.*, 2014). With the revolution of laparoscopic surgery in 1990, came the development of inguinal hernia repairs using the introduction of mesh through the laparoscope (Davis *et al.*, 2010). There are two major laparoscopic approaches, the transabdominal peritoneal repair (TAPP) and the total extraperitoneal repair (TEP) (Hamza *et al.*, 2010). TAPP approach has the advantage of identifying missed additional direct or femoral hernia during the first operation itself (Hamza *et al.*, 2010). The advantages over conventional surgery are primarily pain reduction, shorter length of hospital stay and faster resumption of usual activities. In addition, many studies also show lower morbidity rates and less impairment of the immune system (Bittner, 2006). Disadvantages of the laparoscopic technique compared with conventional surgery include the higher operating room costs and the need for general anesthesia (Bittner, 2006). However, operation time is longer and there appears to be a higher risk of serious vascular injuries (McCormack *et al.*, 2003). During laparoscopic repair of inguinal hernia using TAPP technique there are different methods for mesh fixation such as using tacker clips, fibrin glue and self-adhesive mesh or leaving mesh without fixation (Teng *et al.*, 2011). Some authors said that during laparoscopic repair of oblique Inguinal hernia we can leave mesh without fixation this is can decrease Post-operative pain and incidence of nerve injury. also, we can use Histoacryl fixation (Davis *et al.*, 2010).

### 1.1 Aim of the work

The objective is to find out the best method of fixation of mesh in TAPP repair of inguinal hernia and the complication of each method. As well as Evaluation of the intra-operative and post-operative complications comparing between these methods.

## 2. Patients and methods

This is a prospective randomized controlled study. It included 90 adult male and female patients with inguinal hernia divided into 3 equal groups all patients had (TAPP), transabdominal preperitoneal mesh hernioplasty.

- **Group A:** (n: 30 patients, with 30 hernia) fixed by tacker clips (secure strap).
- **Group B:** (n: 30 patients, with 30 hernia) fixed with fibrin glue.
- **Group C:** (n: 30 patients, with 30 hernia) with self-fixing mesh .

These patients presented to the outpatient clinics at Maadi Military Hospital and Kasr AL Aini teaching hospital and were randomized into 3 equal groups.

- Starting from June 2017 to December 2018.

- Each patient has an equal chance to be included in any group.

### 2.1 Method of randomization

Simple randomization via a computer-generated list with a serial number from 1-90, patient was allocated according to his number. Data was collected in a case form, it entailed the variables needed for this study (patient demographics, comorbidities, intraoperative complications, postoperative complications and follow up).

### 2.2 Inclusion criteria

All patients 18 years old or above. All patients having uncomplicated inguinal hernia either direct, indirect or both.

### 2.3 Exclusion criteria

Patients unfit for general anaesthesia. Patients with a systemic disease that is a constant threat to life. Those with complicated inguinal hernia such as irreducibility, bowel obstruction, bowel strangulation, peritonitis or bowel perforation. Patients under 18 years of age. Huge inguinal hernia. All patients included in the study were subjected to : History taking, general, local examination and routine preoperative investigations including abdominal ultrasonography. Informed written consent. Evaluations of the operative time, blood loss, mesh size and material, method and material of mesh fixation and any intra-operative complications. Postoperative evaluation of pain, need for analgesia, length of hospital stays and post-operative complications (mainly hematoma and hydrocele). Follow up for 18 months to compare the effectiveness, safety and patient satisfaction of these 3 groups. The main method of assessment was clinical assessment by surgeon ability to prespecified treatment plan . Routine investigations for all patients, including Complete blood picture. Coagulation profile. Liver function tests. Kidney function tests. Fasting blood sugar. ECG. Chest x-ray. Comorbidities like COPD, cardiac diseases, chest diseases and diabetes mellitus were controlled preoperatively.

### 2.4 Preoperative preparation

Abdominal and groin hair were shaved. Patients were asked to void urine just before operation. Prophylactic antibiotic one gram of first generation cephalo-sporine was given one hour before operation. Routine 6 hours preoperative fasting.

### 2.5 Material properties

Mesh: polypropylene 15X10. Progrid Self-fixing mesh (Covidien). Tacks: securstrap absorbable (Ethicon). Fibrin glue.

### 2.6 Surgical steps

#### 2.6.1 Anaesthesia

General anaesthesia with endotracheal intubiation.

#### 2.6.2 Position

Patient lies supine with both upper limbs beside his abdomen. Trocars: 3 trocars were used, the first is 5-12 mm in the umbilical crease (for introducing the mesh and

telescope), the other 2 trocars are 5 mm at right and left quadrants at or above the umbilicus.

### 2.6.3 Optic

10 mm, 30° view

#### 2.6.3.1 Position of surgeon and assistance

Both of them stand on the opposite side to the hernia. The laparoscopic tower including the monitor stands at the foot of the patient.

#### 2.6.4 Steps

The abdomen was insufflated using Veress needle through umbilical crease incision. It is done under continuous pressure of 14mmHg. 10mm trocar was introduced through the umbilical incision. Exploration of the whole abdomen is done. The other trocars were introduced under vision at lateral border of rectus ms at same level or different levels. Dissection started by opening the peritoneum at a point above and medial to ASIS. This was done using harmonic scalpel, scissors, or hook with diathermy according to availability. The peritoneal opening continued medially till the medial umbilical ligament passing above the hernia defect. The lower flap was dissected down till the peritoneal reflection over the posterior abdominal wall. In oblique hernia the sac usually divided at the internal ring leaving the distal part. In direct hernia the sac is dissected completely out of the defect. The vas deference and spermatic vessels dissected from the sac till the peritoneal reflection over the posterior abdominal wall. The upper flap dissected till the arcuate ligament (lower part of the posterior rectus sheath) where the inferior epigastric vessels disappear. Dissection was made medial to inferior epigastric vessels to expose the Cooper's ligament.

### 2.7 Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SP SS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. The following tests were done :A one-way analysis of variance (ANOVA) when comparing between more than two means. Chi-square ( $\chi^2$ ) test of significance was used in order to compare proportions between two qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: Probability (P-value). P-value <0.05 was considered significant. P-value <0.001 was considered as highly significant. P-value >0.05 was considered insignificant.

## 3. Results and discussion

Herniorrhaphy is one of the most commonly performed operations. Worldwide, 20 million groin hernia repairs are accomplished each year. The main outcomes of interest are operative time, complications, postoperative pain, return to activities, recurrence rates, and cost. According to Hawn and colleagues, the two most important indicators of an effective inguinal herniorrhaphy are recurrence and pain (Hawn et al., 2006). The choice of an  
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appropriate surgical approach is difficult in the treatment of inguinal hernia (Pisanu et al., 2015). Laparoscopic repairs provide very good results as it has lower postoperative pain, fewer wound infection, and quick return to daily activity (Karthikesalingam et al., 2010). A recent meta-analysis comparing between the laparoscopic repair versus open Lichtenstein procedure showed that significantly fewer patients with chronic pain were found in the laparoscopic group. Patients treated by laparoscopy had a significantly earlier return to normal daily activities than patients of the Lichtenstein group but the main disadvantage of laparoscopic repair has been the duration of the operation as the mean operative time was significantly longer in the laparoscopic operations (Pisanu et al., 2015). The longstanding standard practice for TAPP was to use mesh fixation with tackers to prevent recurrence but atraumatic mesh fixation methods are being increasingly used to prevent chronic pain in the wake of traumatic fixation methods (Mayer et al., 2016). The current surgical options for mesh fixation include sutures, tacks or staples, self-fixing meshes and fibrin or other glues. However, there is no consensus on the best surgical technique and the choice of options often depends on surgeons' personal preference (Ge et al., 2015). Self-adhesive meshes are a relatively new advancement in inguinal hernia repair; they have been used in both open and laparoscopic operations reducing the complication risk as lower rates of recurrence and postsurgical pain, also shorten operation time, and lowers the expense that come with the mechanical fixation of the implanted mesh (Mathavan & Arregui, 2013). Hence, we hereby conducted a randomized prospective study, over an 18 months period, in order to compare multiple aspects between self-fixing mesh, staples or fibrin glue for mesh fixation in laparoscopic TAPP repair of inguinal hernia from different points of view including operation duration, postoperative pain, postoperative complications, postoperative hospital stay, time needed to return to normal activity, and most importantly the recurrence.

This was a prospective randomized controlled study. It included 90 adult male and female patients with inguinal hernia divided into 3 equal groups all patients had (TAPP), transabdominal preperitoneal hernioplasty. These patients presented in the outpatient clinics at Maadi Military Hospital and Kasr AL Aini teaching hospital and randomized into three balanced groups, Group A: (n: 30 patients, with 30 hernia) fixed by tacker clips (secure strap), Group B: (n:30 patients, with 30 hernia) fixed with fibrin glue and Group C: (n: 30 patients, with 30 hernia) with self-fixing mesh. Simple randomization via a computer-generated list with a serial number from 1-90, patient allocated according to their number. Patients in each groups were similar with respect to age; the patients ages ranged from 18 to 60 years, most of them were male patients with a male to female ratio (88/2) with the two female patients in group B having no significant difference between both groups as regards sex with a mean age of 40 years in each group and this This adds value to our study in evaluating the procedure in different age groups and in both genders. This age of presentation was noticed to be earlier than various studies assessing the self-fixing group as in a recent study conducted by (Birk et al., 2013). More than 220 hernias with a mean follow-up at 23 months in Germany, the mean age of the studied population was 54 years, the younger age of

presentation in our study was surely explained by the heavy occupational nature of most of the studied cases adding to the value of our study in evaluating the procedure in different age groups. The same age group was observed in an Indian study recently which studied the inguinal hernia risk factors. It stated that the age range of the most common patients who suffered from inguinal hernia ranged from 46 to 60 years (*Balamaddaiah & Reddy, 2016*).

Most of the studied patients were men to match the male predominance as regards the patient's flow for recruitments and this predominance of hernia in men was attributed to the fact that there was involvement of more strenuous exercises and lifting of weights by them and the anatomical differences between the two sexes (*Balram, 2016*). Different kinds of inguinal hernias were included: in the tacker group A: Direct hernia 5 cases (16.7%), indirect 20 cases (66.7%) and dual hernia 5 (16.7%), Primitive 25 (83.3%) and recurrent 5 (16.7%). In the fibrin glue group B: Direct hernia 4 (13.3%) indirect 24 (80.0%) and dual hernia 2 (6.7%), Primitive 27 (90.0%) and recurrent 3 (10.0%). In self-fixing mesh group C: Direct hernia 7 (23.3%) indirect 20 (66.7%) and dual 3 (10.0%), Primitive 26 (86.7%) and recurrent 4 (13.3%). This reflected the value of the study in evaluating the maneuver in different kinds of inguinal hernia. In our study mean intra-operative time for glue group was  $68.67 \pm 10.59$  (55-85) while for tack group was  $65.27 \pm 6.45$  (55-80) and for self-fixing group was  $66.90 \pm 7.48$  (58-85). So, this study showed that tacker technique as a method for mesh fixation was faster than other methods. In self-fixing group there are some difficulties in handling the mesh as it is easily attaching to surrounding structures and the time taken to prepare the fibrin glue all this makes the tacker method of fixation was faster to somehow but not reaching statistical significance ( $p > 0.05$ ). The mean operative time in the self-fixing mesh group was very close to the operation time taken during a prospective randomized trial conducted by the University of Turin in Italy which assessed the self-fixing group in laparoscopic inguinal hernia repair in young and elderly patients as their operation time ranged from  $70.4 \pm 12.8$  min (*Ferrarese et al., 2016*).

The same operation time was taken in a study which included 96 patients comparing in a prospective manner between self-fixing versus staple fixation in laparoscopic inguinal hernia where the mean duration of the procedures was 83 min in the self-fixing group (*Romario et al., 2013*). Meta-analysis of the four RCTs showed that fibrin group appeared to be less time consuming than the staple group, although there was no significant difference (Std Mean Difference = 0.74, 95 % CI -0.15, 1.63,  $p = 0.11$ ) (*Shi et al., 2017*). In the non-RCTs, *Olmi et al. Ceccarelli et al. and Bittner et al.* reported that operating time of staple group was shorter than that of fibrin group (*Ceccarelli et al., 2008; Olmi et al., 2007*). Another study also showed that no difference about the mean operative time between the glue group and tacker group. However, the operative time of glue group was longer by about 6 min mean compared with the tacker group, this was due primarily to the preparation of glue and its accurate application which was matched with our study (*Ferrarese et al., 2014*). No significant difference was found between the operative time length needed to apply ProGrip mesh versus mesh fixation with tacks and glue approach. However, the self-fixing group needed some

experience to place it correctly as it adheres easily with the surrounding structures. Regarding to the postoperative hospital stay our study between the 3 groups revealed that the tacker groups average was  $(1.20 \pm 0.55)$  for fibrin glue group  $(1.17 \pm 0.38)$  and for self-fixing group  $(1.10 \pm 0.31)$ , so no significant difference as regards days of hospital stay and return to normal activity ( $p > 0.05$ ). and this was conducted with another study which was done on 2014 over 160 patients comparing between mesh fixation with fibrin glue and tacker and the results were: the average for the glue group was (1.3) and for the tacker group was (1.5) (*Ferrarese et al., 2014*). Our results also matched with the prospective study done on 200 patients to compare between fibrin glue and tacker for fixation of mesh regarding to the post-operative hospital stay which was 1 day stay at the hospital (*Lovisetto et al., 2007*).

Another study which was applied for 60 patients showed that postoperative length of hospital stay was comparable for self-fixing mesh method and tacker method; both were performed as day surgery with one night in hospital and only a very small number of patients (3 in the tacker group, 2 in the self-fixing group) had to stay two nights the mean ( $\pm$  SD) for the self-fixing group  $(1 \pm 0.2)$  and the same for tacker group. Analytical comparison of post-operative length of hospital stay revealed no statistically significant differences between two groups (*Ferrarese et al., 2016*). So overall no statistically significant difference between the 3 groups and the review of literature regarding to the post-operative hospital stay. In our study we found that comparative study between the 3 groups revealed; 2 patient vascular injury which was controlled using cautery and endo clip, and only one patient nerve injury, in tacker group (6.7%, 3.3% respectively); compared to other groups; but not reaching statistical significance ( $p > 0.05$ ). And this did not match with the results obtained from the prospective study performed on 60 patients comparing between the fibrin glue and self-fixing mesh fixation which revealed only one intraoperative complication (vascular injury in the self-fixing group (*Ferrarese et al., 2016*)). Another study was performed over 200 patients comparing between usage of fibrin glue and usage of tacker for mesh fixation showed no intraoperative complication which was mismatched with our study but not to the level of statistical significance (*Lovisetto et al., 2007*). Also, another study was performed over 70 patients comparing between mesh fixation with tacker and fixation with vicryl stitches and the results showed no intraoperative complications. So most of the studies show no intraoperative complication especially with a well-trained laparoscopic surgeon (*Kleidari et al., 2014*). Some postoperative complications may occur after laparoscopic procedure. These include urinary retention, seroma formation, groin hematoma, neuralgia, groin pain, testicular problems, wound infection, and mesh complications, recurrence (*Fitzgibbons et al., 1995*). Seroma formation has been documented as one of the most common complications of the repair of inguinal hernia, either by open or laparoscopic techniques (*Olmi et al., 2007*). In our study post-operative seroma or hematoma has occurred in only in one case (3.3%) in tacker and self-fixing group and 3 cases (10 %) in fibrin glue group which has been disappeared in the next 3 months follow up without intervention. So the rate of seroma formation was greater in the fibrin glue group than the other 2 groups but not reaching

to statistical significance. one of the studies revealed that only 5.7% of cases done by glue showed post-operative seroma while 6% of cases done by tacks showed post-operative seroma (Santoro et al., 2007), another study showed that only 1% of cases done by glue showed signs of post-operative seroma in comparison to more than 2% of cases done by other methods (Olmi et al., 2007).

However, some other studies showed no significant difference regarding post-operative seroma formation for different methods of fixation (Ceccarelli et al., 2008). Another study was matched with our study performed over 60 patients comparing between self-gripping mesh versus fibrin glue fixation in laparoscopic inguinal hernia repair: a randomized prospective clinical trial in young and elderly patient: revealed only one case with seroma formation with the fibrin glue group which has been disappeared in the follow up appointments (Ferrarese et al., 2016). We found that comparative study between the three groups revealed; a significant decrease in pain scores over time, in group-III (at day-0); compared to group-II (at 1 week); compared to in group-I (at 12 months), with significant statistical difference ( $p < 0.001$ ). Our results came in agreement with Tish et al., 2020, who reported that, there was no statistically significant difference between any fixation method when evaluating pain as a binary variable (Yes/No). However, when looking at the VAS evaluation for pain, Group A was only better than Groups B and C fixation in the pain domain (Tish et al., 2020). Most of studies comparing different methods for mesh fixation found that acute pain in the post-operative period was higher in staples group reaching a maximum score of 4 only in terms of 10 mm trocar site post-operative pain, but the pain disappeared after 30 days. however, this pain maybe associated to fascial suture to secure the site port for the prevention of post-operative complications (Ceccarelli et al., 2008). Also, another study revealed that patients rated their pain as greatest between 24 and 72 postoperative hours, where pain was rated as lowest in severity in the glue group. The mean maximum pain score reported by glue group patients was VAS2 (mild pain) during this period. In contrast, mean pain scores ranged between VAS5 and VAS7 (moderate to severe pain) with tack group between 24 and 72 postoperative hours (Olmi et al., 2007). Another study also showed that, for the glue group only 4.5% of patients showed chronic pain while 6.3% of patients from other groups showed continuous pain till >3 months period (Andresen et al., 2017). Also, other study showed that, ten trials, with a total of 1418 participants reported the number of people with chronic pain (at least 3 months postoperatively; follow-up 3 to 60 months). There was an overall reduction of chronic pain by 37% with fibrin glue (Sun et al., 2017).

Another study showed that, Postoperative pain at 6 months from surgery, measured by visual analogue score (VAS), was reported by around 11% of patients in the tack group and in no case of the glue group ( $P=0.04$ ) (Burza et al., 2014). Our results also came in agreement with Habeeb et al., 2020, who reported that, there was no statistical difference between groups (A) and Group (C) regarding operative time, postoperative complications, and length of hospital stay and risk of chronic groin pain, postoperative pain score. In Group (B): the postoperative pain and complications were higher. There were 5 cases of hernia recurrence in all groups, but no significant differences (Dowara et al., 2023)

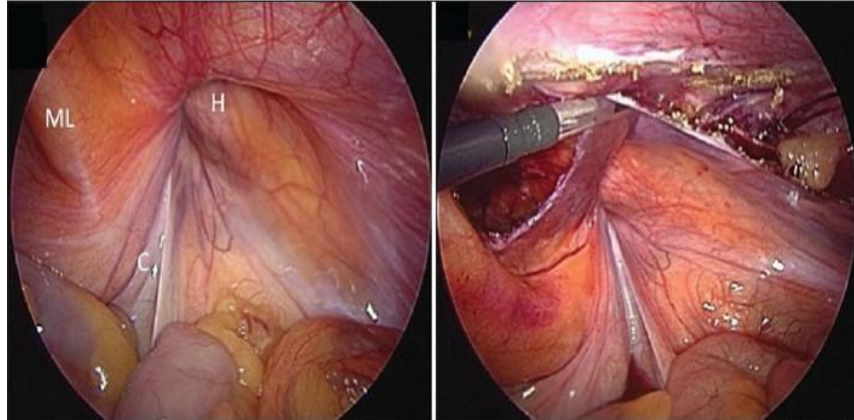
among the three groups (Habeeb et al., 2020). Recurrence after inguinal hernia repair is one of the most important measurable outcomes. It is largely determined by technique and can only accurately be reported with complete long term follow-up (Takata & Duh, 2008). For comparison between fixation methods, the rate of recurrence was higher in the ST (staple fixation) group compared to the FG (fibrin glue) group (5.4% vs. 2.2%), but this difference was not statistically significant; a possible explanation could be the higher amount of EHS L3 and combined as well as recurrent hernia defects in the ST group (Wirth et al., 2019). We also found that comparative study between the 3 groups revealed; an increase in 1-week, 3, 6, 12, and 18-month recurrence rates, in group-II (3.3%, 6.7% respectively); compared to other groups; but not reaching statistical significance ( $p > 0.05$ ). Our results came in agreement with Qureshi et al., 2020, who reported that, there was non-significant difference in recurrence rates between mesh and non-mesh methods (2.04%) versus (0%) (Qureshi et al., 2020). Our results also came in agreement with Ielpo et al., 2020, who reported that, The use of fibrin glue for TAPP inguinal hernia repair is a safe and feasible technique with favorable results (none had a recurrence) (Ielpo et al., 2020). A mesh measured 15X10 cm was introduced through the umbilical trocar and spread over the dissected area to cover the area medially behind the medial umbilical ligament, laterally to vertical plain from the point above and medial to ASIS till the peritoneal reflection, down to the peritoneal reflection over posterior abdominal wall, and above to the arcuate line.

### 3.1 Fixation of the prosthesis

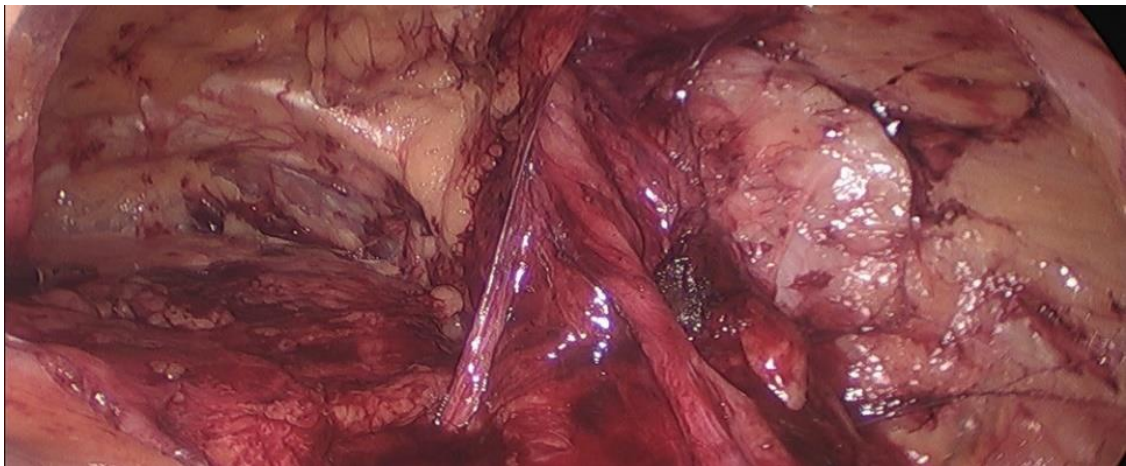
Progrip self-fixing mesh, we introduced the prepared implant through the 12 mm trocar, which is folded (15 × 10 cm). None of the meshes were not tailored. The implant was spread out in the abdominal cavity and placed to the groin in order to cover the hernia opening by at least 5-6 cm to all directions and also to cover other preformed weaker sites in the groin. Fixation to abdominal wall was accomplished by gently pressing the implant against the abdominal wall using a surgical instrument. Fixation was based on a mechanical effect involving the adherence of grips to tissue. The reconstruction of parietal peritoneum followed, with continuous absorbable suture vicryl 2-0. Polypropylene mesh of about 15 × 10 cm was used and tailored to each patient. It is advisable to use a larger mesh (12 × 17) for major defects. The mesh is rolled and introduced into the abdomen through a 5–12 mm trocar, positioned to cover the hernia defect and the entire inguino-femoral region (potential hernia spaces). It's important to ensure that the inferior border of the mesh stays in place when the peritoneum is lifted. The aim of mesh fixation was to prevent mesh displacement and consequent recurrence. In order to fix the mesh, we used tacks or glue. By using two clips the mesh was fixed to the symphysis and Cooper's ligament. Two other clips were placed on the rectus muscle medial to the epigastric vessels and two other ones at the transverse fascia located lateral to the epigastric vessels. Placing clips below the ileopubic tract and 1–2 cm above was strictly avoided doing so could lead to injuring large vessels (Triangle of doom) or nerves (triangle of pain). When fibrin glue was used, a special 5 mm laparoscopic applicator is required using a 3-mm catheter (Duplotip; Baxter Healthcare), which fits the fibrin glue syringe, and 2

ml of fibrin glue with small drops around the mesh border; there was no need to look for vessels or nerve location. As soon as the mesh was placed in position, the peritoneal incision must be approximated using a suture (adsorbable

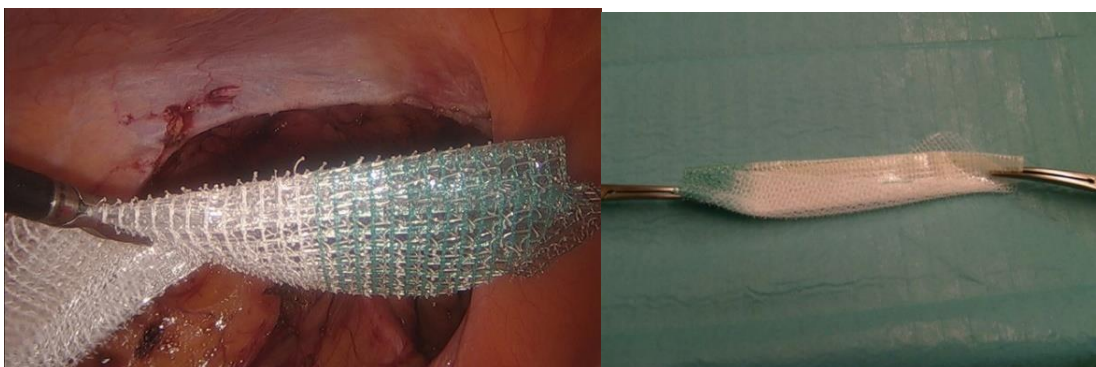
manufactured suture) whose ends get fixed with adsorbable clips or intracorporeal knotting. Peritoneum closure using 2-0vicryl.



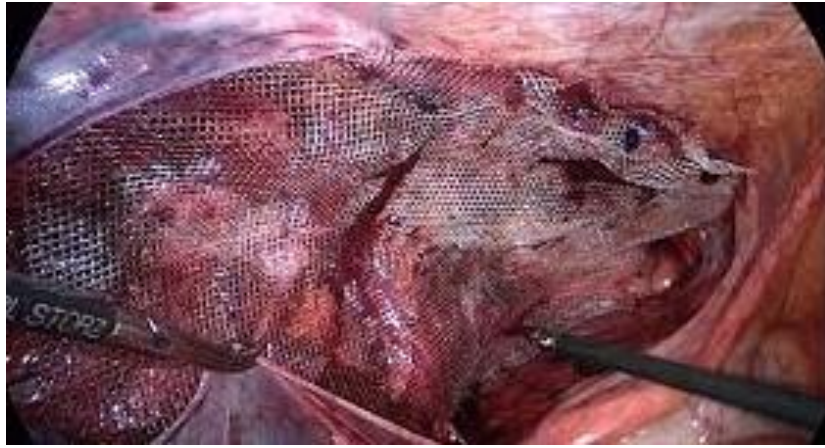
**Figure 1:** Peritoneal flap being developed using a transverse peritoneal incision placed above the hernial orifice; ML = Medial umbilical ligament; C = cord structures



**Figure 1:** Situation after termination of dissection



**Figure 2:** Folded progrip mesh and its implantation.



**Figure 4:** Image of using tacker in mesh fixation



**Figure 5:** Image of using fibrin glue in mesh fixation



**Figure 6:** Closure of peritoneum using vicryl 2-0

**Table 1:** Comparison between groups according to demographic data.

Demographic Data	Group I: Tacker (N=30)	Group II: Fibrin glue (N=30)	Group III: Self-fixing mesh (N=30)	x <sup>2</sup>	p-value
<b>Sex</b>					
Male	30 (100.0%)	28 (93.3%)	30 (100.0%)	4.091	0.129
Female	0 (0.0%)	2 (6.7%)	0 (0.0%)		
<b>Age (years)</b>					
Mean±SD	37.30±11.00	39.40±12.54	36.00±10.54	F=0.681	0.509
Range	19-55	18-64	20-65		

F-ANOVA test; x<sup>2</sup>: Chi-square test; p-value >0.05 NS

**Table 2:** Comparison between groups according to type of hernia.

Type of hernia	Group I: Tacker (N=30)	Group II: Fibrin glue (N=30)	Group III: Self-fixing mesh (N=30)	x <sup>2</sup>	p-value
<b>Direct</b>	5 (16.7%)	4 (13.3%)	7 (23.3%)	2.775	0.596
Indirect	20 (66.7%)	24 (80.0%)	20 (66.7%)		
Dual	5 (16.7%)	2 (6.7%)	3 (10.0%)		
<b>Primitive</b>	25 (83.3%)	27 (90.0%)	26 (86.7%)	0.577	0.749
Recurrent	5 (16.7%)	3 (10.0%)	4 (13.3%)		

x<sup>2</sup>: Chi-square test; p-value >0.05 NS

**Table 3:** Comparison between groups according to co-morbidities.

Co-morbidities	Group I: Tacker (N=30)	Group II: Fibrin glue (N=30)	Group III: Self-fixing mesh (N=30)	x <sup>2</sup>	p-value
<b>Smoking</b>					
No	20 (66.7%)	21 (70.0%)	19 (63.3%)	0.300	0.861
Yes	10 (33.3%)	9 (30.0%)	11 (36.7%)		
<b>DM</b>					
No	28 (93.3%)	28 (93.3%)	26 (86.7%)	1.098	0.578
Yes	2 (6.7%)	2 (6.7%)	4 (13.3%)		
<b>HTN</b>					
No	27 (90.0%)	29 (96.7%)	26 (86.7%)	1.921	0.383
Yes	3 (10.0%)	1 (3.3%)	4 (13.3%)		
<b>COPD</b>					
No	29 (96.7%)	28 (93.3%)	28 (93.3%)	0.424	0.809
Yes	1 (3.3%)	2 (6.7%)	2 (6.7%)		
<b>Prostatism</b>					
No	30 (100.0%)	29 (96.7%)	27 (90.0%)	3.663	0.160
Yes	0 (0.0%)	1 (3.3%)	3 (10.0%)		

x<sup>2</sup>: Chi-square test; p-value >0.05



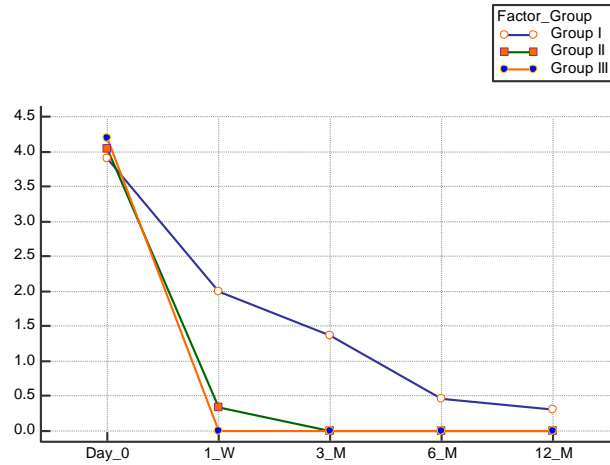


Fig. 7: Multi-variate graph between groups according to pain scores.

Table 4: Comparison between groups according to timing.

Timing	Group I: Tacker (N=30)	Group II: Fibrin glue (N=30)	Group III: Self-fixing mesh (N=30)	ANOVA	p-value
<b>Operating time (min)</b>					
Mean±SD	65.27±6.45	68.67±10.59	66.90±7.48	1.241	0.294
Range	55-80	55-85	58-85		
<b>Hospital stay (days)</b>					
Mean±SD	1.20±0.55	1.17±0.38	1.10±0.31	0.432	0.651
Range	1-3	1-2	1-2		
<b>Return to normal activity (days)</b>					
Mean±SD	7.90±1.42	7.40±1.48	7.77±1.45	0.955	0.389
Range	6-12	5-12	5-13		

F-ANOVA test; p-value >0.05 NS

Table 5: Comparison between groups according to intraoperative complications.

Intraoperative complications	Group I: Tacker (N=30)	Group II: Fibrin glue (N=30)	Group III: Self-fixing mesh (N=30)	x <sup>2</sup>	p-value
<b>intraoperative</b>					
No injury	27 (90.0%)	30 (100.0%)	30 (100.0%)	6.207	0.184
Vascular Injury	2 (6.7%)	0 (0.0%)	0 (0.0%)		
Vas injury	0 (0%)	0 (0%)	0 (0%)		
Visceral injury	0 (0%)	0 (0%)	0 (0%)		
Nerve injury	1 (3.3%)	0 (0.0%)	0 (0.0%)		

x<sup>2</sup>: Chi-square test; p-value >0.05 NS

**Table 6:** Comparison between groups according to early postoperative complications.

Early postoperative complications	Group I: Tacker (N=30)	Group II: Fibrin glue (N=30)	Group III: Self-fixing mesh (N=30)	x <sup>2</sup>	p-value
<b>Week 1</b>					
No	28 (93.3%)	26 (86.7%)	29 (96.7%)	11.169	0.192
Hematoma	1 (3.3%)	0 (0.0%)	1 (3.3%)		
Seroma	0 (0.0%)	3 (10.0%)	0 (0.0%)		
Orchitis	0 (0.0%)	1 (3.3%)	0 (0.0%)		
Infection	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Neurolgia	1 (3.3%)	0 (0.0%)	0 (0.0%)		
Mesh complications	0 (0.0%)	0 (0.0%)	0 (0.0%)		
<b>3 month</b>					
No	29 (96.7%)	29 (96.7%)	29 (96.7%)	3.000	0.558
Hematoma	1 (3.3%)	0 (0.0%)	1 (3.3%)		
Seroma	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Orchitis	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Infection	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Neurolgia	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Mesh complications	0 (0.0%)	1 (3.3%)	0 (0.0%)		

x<sup>2</sup>: Chi-square test; p-value >0.05 NS

**Table 7:** Comparison between groups according to VAS score.

Timing	Group I: Tacker (N=30)	Group II: Fibrin glue (N=30)	Group III: Self-fixing mesh (N=30)	ANOVA	p-value
<b>Pain score (VAS) (Day-0)</b>					
Mean±SD	3.9 ± 0.84	4 ± 0.92	4.2 ± 0.84	0.887	= 0.416
<b>Pain score (VAS) (1 week)</b>					
Mean±SD	2 ± 0.83	0.33 ± 0.54	0 ± 0	104.53	< 0.001**
<b>Pain score (VAS) (3 months)</b>					
Mean±SD	1.36 ± 0.49	0 ± 0	0 ± 0	233.24	< 0.001**
<b>Pain score (VAS) (6 months)</b>					
Mean±SD	0.46 ± 0.5	0 ± 0	0 ± 0	25.375	< 0.001**
<b>Pain score (VAS) (12 months)</b>					
Mean±SD	0.3 ± 0.46	0 ± 0	0 ± 0	12.429	< 0.001**

F-ANOVA test; p-value >0.05 NS

**Table 8:** Comparison between groups according to recurrence.

Recurrence	Group I: Tacker (N=30)	Group II: Fibrin glue (N=30)	Group III: Self-fixing mesh (N=30)	x <sup>2</sup>	p-value
<b>After 1Week</b>					
No	30 (100.0%)	29 (96.7%)	30 (100.0%)	2.022	0.364
Yes	0 (0.0%)	1 (3.3%)	0 (0.0%)		
<b>After 3 months,</b>					
No	29 (96.7%)	28 (93.3%)	30 (100.0%)	2.069	0.355
Yes	1 (3.3%)	2 (6.7%)	0 (0.0%)		
<b>After 6 months</b>					
No	29 (96.7%)	28 (93.3%)	29 (96.7%)	0.523	0.770
Yes	1 (3.3%)	2 (6.7%)	1 (3.3%)		
<b>After 12 months</b>					
No	29 (96.7%)	28 (93.3%)	29 (96.7%)	0.523	0.770
Yes	1 (3.3%)	2 (6.7%)	1 (3.3%)		
<b>After 18 months</b>					
No	29 (96.7%)	28 (93.3%)	29 (96.7%)	0.523	0.770
Yes	1 (3.3%)	2 (6.7%)	1 (3.3%)		

x<sup>2</sup>: Chi-square test; p-value >0.05 NS

At the time of suturing the peritoneum, the intra-abdominal pressure is reduced to 6–8 mmHg. Thereby allowing a tension-free peritoneal closure. The procedure, was terminated by removing all trocars under vision because of the risk of bleeding. Skin incisions were closed by stitches. No drain into the abdomen was required. In patients with bilateral hernias, the same procedures were performed sequentially to repair the hernia on the other side (generally smaller). **Primary outcomes** (Most important outcomes to be assessed). Rate of recurrence after 18 months follow up. **Secondary outcome parameters** (other outcomes to be assessed). Pain control. Intraoperative complication (Vascular injuries., Nerve injuries, Visceral injuries and injury of vas deference. Mesh complications: migration-fibrosis-rolling. Postoperative complications (seromas, hematoma and, hydrocele). Comparative study between the three groups revealed; an increase in indirect and primitive hernias, in group-II (80%, 90% respectively); compared to other groups; but not reaching statistical significance (p > 0.05) this is shown in table (4). Comparative study between the three groups revealed; an increase in DM, HTN and prostatism, in group-III (13.3%, 13.3%, 10% respectively); compared to other groups; but not reaching statistical significance (p > 0.05). Comparative study between the 3 groups revealed non-significant difference as regards smoking, and COPD (p > 0.05) as shown in table (5) Comparative study between the three groups revealed; an increase in operative time, in group-II (68.67±10.59 min); compared to other groups; but not reaching statistical significance (p > 0.05). Comparative study between the three groups revealed non-significant difference as regards days of hospital stay and return to normal activity (p > 0.05). Comparative study between the three groups revealed; an increase in vascular injury and nerve injury, in group-I (6.7%, 3.3% respectively); compared to other groups; but not reaching statistical significance (p > 0.05) as shown in

table (7). Comparative study between the three groups revealed; a decrease in 1-week complications rate, in group-III (3.3%); compared to other groups (6.6%, 13.3%); but not reaching statistical significance (p > 0.05). Comparative study between the three groups revealed non-significant difference as regards follow up 3 m complications (3.3% respectively) (p > 0.05).

Comparative study between the three groups revealed; a significant decrease in pain scores over time, in group-III (at day-0); compared to group-II (at 1 week); compared to in group-I (at 12 months), with significant statistical difference (p < 0.001) as shown in table(9). Comparative study between the three groups revealed; an increase in 1-week, 3, 6, 12, and 18-month recurrence rates, in group-II (3.3%, 6.7% respectively); compared to other groups; but not reaching statistical significance (p > 0.05) table (10).

**4. Conclusion**

Mesh fixation using tacker fixation and fibrin glue showed better results than fixation using self-fixing mesh regarding post-operative pain and lack of recurrence, but regarding operative time and post-operative complications, there were no significant difference between the 3 methods, so we recommended that repair using tacker fixation and relatively fibrin glue should take the upper hand.

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