
Analysis of Open Tension Free (Mesh plug and patch) Inguinal Hernia Repair

Amer Hassan Salman
CABS, DS, DML

Abstract:

Background: Inguinal hernia repair is the most frequent operation in general surgery. Until recently the standard has been open musculo-aponeurotic repair using sutures under tension to close the defect, but tension-free repair using prosthetic mesh is becoming increasingly common and considered the standard procedure. Many procedures have been used but still the most effective surgical technique is unknown.

Objective: Assessment of open tension free (Mesh plug and patch) inguinal hernia repair regarding early return to normal activity, postoperative pain, complications and recurrence rate.

Methods: A prospective study of (73) patients with inguinal hernia operated upon, in Al- Yarmouk Teaching Hospital (from Oct. 2005 to Oct. 2009) using the technique of open tension-free inguinal hernia repair (plug and mesh). The data was collected in the proforma designed for the study. The operative time, severity of post operative pain and analgesia, hospital stay, early mobilization, early and late complications and early return to activity, were all assessed.

Results: The operative time was (36 minutes), there is mild postoperative pain that relieved by short term analgesia, and the time for return to activity was after (3-7days) and this was in 59 (95%) patients, and the time interval before carrying out the most strenuous activity was 14 days and it was in 42 (91.3%) patients out of 46 employed patients. There was mild scrotal swelling, Hematoma in 4(6.5%) patients, mild Seroma in one (1.6%) patient, surgical site infection (SSI) in 3(4.8%) patients, no one required surgical interference, one patient (1.6%) had groin hyperesthesia and one patient developed mild swelling relieved after 30 days. There is no recurrence and no chronic disabling pain.

Conclusion: Using open mesh plug and patch inguinal hernia repair showed reduced post operative pain, early rehabilitation, early discharge (6 -24 hours) and early return to activity (after one week) and no recurrence In comparison to other studies using the other open technique, this method looks to be superior to conventional tension repair of inguinal hernia in term of rehabilitation, early return to activity and recurrence.

Key words: Inguinal hernia, open mesh plug and patch, repair.

Introduction:

The technique of plugging the inguinal canals have been first conceived in the mid. 1830 P. N. Gerdy a Parisian surgeon, plugged the inguinal canal without operation using an inverted fold of, scrotal skin. Then C.W Wutzer during the same era used foreign body (wooden plug) to push the scrotal skin and testicle in front of it to hold tissue until inguinal canal was closed by inflammatory adhesions^[1].

With advent of Bassini/Halsted reconstruction of the inguinal floor in 1890⁵, the concept of plugging felt into disfavor and disuse. During the modern era of hernia surgery one century ago, all "tissue based" groin herniorrhaphy have had common disadvantages of creating tension on the suture line using more complex tissue flaps, grafts layers, relaxing incision, resulting in complications including, patient discomfort, prolonged rehabilitation and recurrences^[2], Francis Usher in 1950⁵ used the Prosthetic polypropylene mesh (Marlex) in the repair of inguinal and incisional hernia, Lichtenstein in 1968 began to use a rolled cylindrical or "Cigarette" mesh^[1], then at 1980⁵ Gilbert improves the design of the mesh in to a cone or umbrella shape.

Gilbert classification was devised in 1989 which include five different levels for indirect and direct hernias. Rutkow and Robbins expanded on Gilbert's scheme in 1993 by adding a type VI for pantaloon hernias and a type VII for femoral hernias,(review table-1).^[1, 3] Rutkow and Robbins were used mesh

plugs to treat all types of groin hernia^[4], and in mid 1993 they reported their results on 1700 hand rolled umbrella- plug hernioplasties. There are about 200,000 hernia repairs per year in Germany and about 770,000 in the U.S. In United States 90% of operations are open mesh repairs^[5]. Nowadays the use of prosthetic mesh for open surgical repair of inguinal hernias has become increasingly popular^[6, 7].

The tissue –based hernia repair create tension on the suture line, difficult to repair and associated with patient discomfort with significant postoperative pain and prolonged convalescence. It had shown an unacceptably high recurrence rate of around 15 to 30%.^[8,9]. The tension created in the repair, accounts for a prolonged period of post-operative pain and abstinence from normal activity and work for at least 6-8 weeks^[10]. This had lead to the introduction of the concept of tension-free hernia repair surgery, which is adaptable to any groin hernia. It offers excellent patient comfort and satisfaction.^[10] In mesh–plug repairs recurrence rate was less than 1% for primary hernia repair and 2% for recurrent hernia is reported^[11,12]. The Shouldice technique was considered to be the 'gold standard' at the start of the 1990's and recurrence rates was as low as 1-4% have been achieved^[13,14] after 4-12 years of follow-up. But nowadays, tension-free surgery with mesh has become the standard technique in inguinal hernia surgery^[15]. Several studies concluded that the use of mesh is superior to the non-mesh operations in inguinal hernia surgery

[9, 16], and the open technique is superior also to the laparoscopic technique for mesh repair of primary hernias [17].

This study was conducted aiming to assess the open tension-free (Mesh plug and patch) inguinal hernia repair regarding early return to normal activity, postoperative pain, complications and recurrence rate.

Patients & Methods:

This is a prospective study performed in Al-Yarmouk Teaching Hospital, Department of surgery, Baghdad- Iraq over the period Oct. 2005 till Oct2009. A total number of 73 patients with

primary and recurrent inguinal hernia s underwent elective tension-free (mesh-plug) repair of inguinal hernias with a non-absorbable polypropylene mesh, (Premilene Mesh Dim3.8cm). Emergency inguinal hernia repair are excluded from the study.

Surgical Technique:

Per-operative evaluation of the hernia is made according to the Gilbert/Rutkow and Robbins classification, looking for (1) status of inguinal floor (2) competency of internal ring (3) integrity of the transversalis fascia-transversus abdominis aponeurosis layer, review **table -1**.

Table-1 The seven types groin hernia after Gilbert/Rutkow and Robbins. [1,3]

Classification	Type	Description
Gilbert/Rutkow	I	indirect, normal internal ring
	& Robbins	
II	indirect, moderately enlarged internal ring (> 2finger breadths) or (> 4cm)	
III	indirect, large internal ring ($\geq$ 2finger breadths) or ($\geq$ 4cm)	
IV	Direct, fusiform defect occupies most of The entire floor (intact internal ring)	
V	Direct diverticular defect of the inguinal Floor (intact internal ring)	
VI	Pantaloon (direct and indirect hernia)	
VII	Femoral hernias	

The freely dissected, unopened sac and any adjacent lipomata were then simply placed back through the internal ring into the abdominal cavity.

A mesh plug was fashioned as a cone like shape (opened umbrella) and sutured by 3-0 polyglactin 910[vicryl] to the surrounding tissue to plug the internal ring, as in **figure (1)** which shows the operative steps of plug mesh and patch hernia repair. In pantaloon hernia, placement of two or even more plugs has been used. Interrupted sutures with 2-0 polypropylene were used to secure the

cone, but the onlay patch was not fixed with sutures.

All indirect and direct hernia were reinforced with a second piece

(Premilene-Mesh, polypropylene mesh, non-absorbable Dim. 3.8 cm. B\BRUN) onlay patch which had been splitted, was sutured back to itself to provide an opening for the cord functioning as pseudo- internal ring. The onlay patch serves as a form of prophylaxis against future herniation.

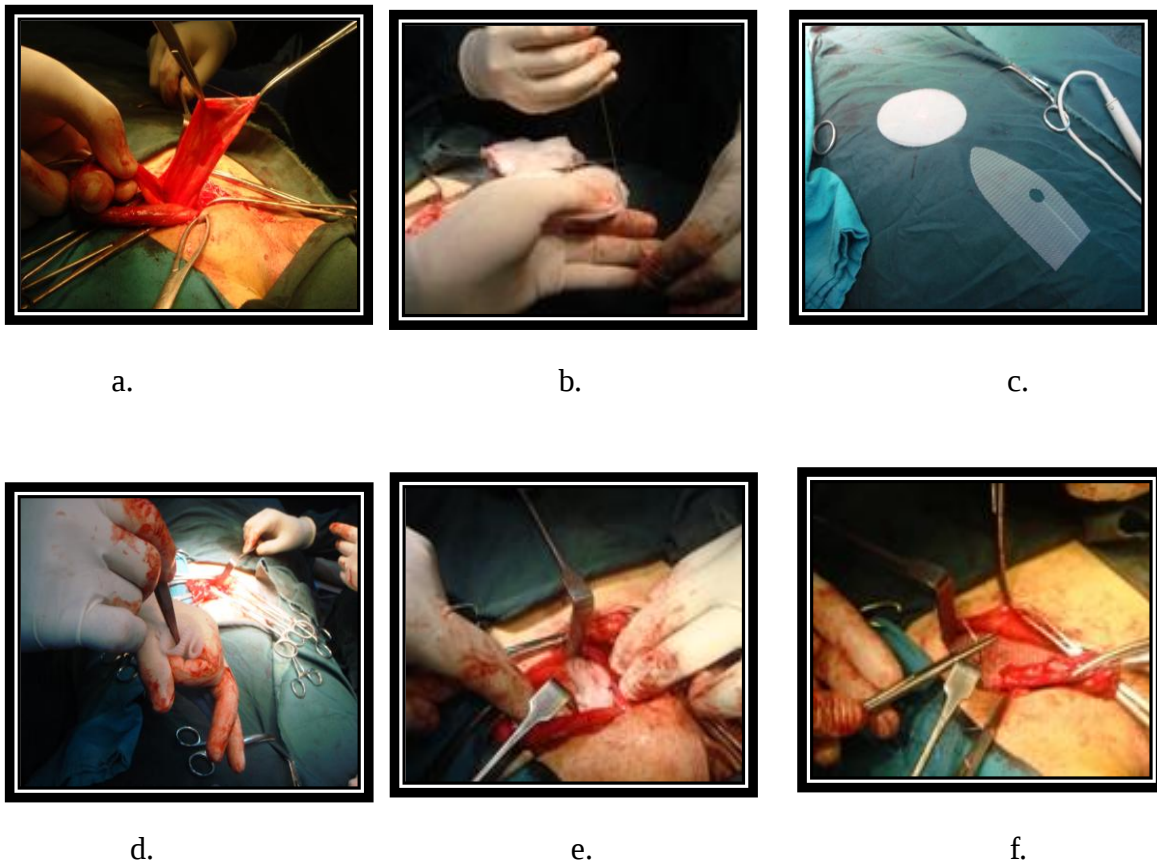


Fig.-1 Operative steps, (a) the unopened sac was simply placed back through the internal ring into the abdominal cavity. (b) Premilene-Mesh, polypropylene mesh, non-absorbable Dim. 3.8 cm. B\BRUN was used to repair the inguinal hernia. (c) Modification of a cone shaped plug (so called open umbrella) (d) Invagination of the plug in to the hernia defect (so called closed umbrella) a technique was not used because of complications. (e) The cone plug was fixed to the transversalis tissues and inguinal ligament. (f) The splitted onlay mesh was sutured back to itself to provide pseudo-internal ring.

Data collected include full, operative findings according to Gilbert/Rutkow and Robbins classification (**table-1**), hospital stay, and ambulation, operative and postoperative complications, which include the early complication that occurs within 30 days and late complication that arise after 30 days. The pain was measured from the severity of postoperative pain (mild, moderate and severe pain) and the dose of postoperative analgesia used (oral tablets or injections), Visual Analogue Scale score method is not use in this study. Mobility and return to normal activity, early scrotal swelling, wound infection, seroma, local discomfort, if any, were reported in the early postoperative period. In the late follow up; we are looking for painful operative site, mesh related sinuses, parasthesia and recurrences. Any preoperative morbid condition was treated accordingly with corresponding medications.

Patients were encouraged to ambulate after 5-6 h. of surgery and were permitted to go home after they were able to ambulate on their own. Every patient who was doing office work was advised to return to their work from the 3rd postoperative day. The follow-up schedule was explained to the patient at the time of discharge and was scheduled at 7th postoperative day for suture removal, then at 2 weeks, then at 1 month, then every two months for two years, depending on patient's compliance. Any patient reported cough impulse was regarded as a recurrence.

Results:

Sixty two out of (73) patients (84.9%) were followed for 48 months (Mean of 13.9 ± 8.7 months). They were (58) males and (4) females, with a mean age of (44.74 ± 17.41) ranging from 17 – 80 years. (35) left inguinal hernia, (27) right inguinal hernia, (3) bilateral hernia, (5) recurrent hernia and (1)

femoral hernia. The hospital stay was (6 to 24 hours), except one patient with recurrent inguinal hernia who developed retention of urine, the hospital stay was (4) days. (11)Patients were lost for follow-up.

The patient's characteristics are presented in (table-2):46 (74%) patients were Employed (heavy

and simple works), all types of hernias were included, the operation performed electively, but history of obstruction had been present in 5 (8%) patients, and 7 (11.2%) patients have had history of trauma.

Table- 2: The socio-demographic information of the examined patients

Number	62 patients
Mean age	44.74(SD 17.41) years
Sex ratio	58 male: 4female
Employment status:	
Employed	46 (74%)
Retired	8 (13%)
Not employed	6 (9.6%)
Not known	2 (3.2%)
Side	
Right	27(43.5%)
Left	35(56.4%)
Bilateral	3(4.8%)
History of trauma	7 (11.2%)
History of obstruction	5 (8%)

Sixty-one patients (98.3%) operated as day surgery, only one (1.6%) patient who have operation for recurrent inguinal hernia, develops urine retention, although he had no PBH, stay for four days (after removal of the Foley's catheter).this patient developed swelling at the site of surgery (seroma), with no cough impulse and disappeared after one month.

3 (4.8%) of the patients had bilateral inguinal hernia, the operation was performed for one side only.

The preoperative morbidity assessment of the patients revealed the following: Nine (14.5%) patients have uncontrolled obstructed air way diseases like bronchial asthma, chronic bronchitis, were treated and assessed by pulmonary function

test .Eight (12.9%) patients had BPH were assessed clinically and investigated by laboratory and US and treated for urinary tract infections, if any. No patient has developed postoperative urine retention. Prophylactic prostatectomy was not performed for those with B.P.H patients before hernia repair (depending on Robbins and Rutkow criteria). One patient had controlled epilepsy **table 3.**

The intra-operative findings regarding the types of inguinal hernia were explained in **table-4.** Three of the patients have bilateral inguinal hernia; the repair was performed for one side only.

The intra-operative classification after Gilbert/Rutkow and Robbins explained in **table- 5**

Table- 3 Preoperative morbidity assessment

Preoperative morbidity	No. patients	%
Obstructive airway disease	9	14.5
Benign Prostatic Hypertrophy (BPH)	8	12.9
Epilepsy	1	1.6
Total	18	38

This co-morbidity has good aetiological factor in raising intra-abdominal pressure

Table 4: The types of hernia

Type of hernia	No. patients	%
Direct	30	48.3
Indirect	28	45.2
Pantaloon	3	4.8
Femoral	1	1.6
Recurrent	5	8

Table-5 intra-operative findings after Gilbert/Rutkow and Robbins classification:

Gilbert classification	No. patients	%
1	4	6.5
2	5	8
3	21	33
4	10	16.1
5	18	29
6	3	4.8
7	1	1.6

Fifty seven (92%) of the patients had primary hernia repair. 5 (8%) of the patients had recurrent inguinal hernia, none of the patients experienced complication during operation, nor significant morbidity in the immediate post-operative period, while the pain was minimal in 54 (87%) patients, it was easily controlled by the use of a single dose of (Tremadol 100 mg) post-operatively and (Paracetamol tab.500mg t.i.d) 4-7 days.

Eight (13%) patients, the pain was moderate and can be controlled by two doses of diclofenac inj.75 mg. (voltaren) and (Paracetamol tab.500mg t.i.d) 4-

7 days. We classify the severity of post-operative pain, according to the analgesia used for relieving pain, **table-6**. Moderate pain: the pain increased with movements, and relieved by more doses of analgesia.

All patients were mobilized 6 hours after surgery. Patients returned to their usual activities gradually after an average of 3 days. By the 2nd week, free unlimited activities, were possible, as explained by **Table-7 and table-8**.

Table-6 The severity of post-operative pain and the analgesia used for relieving pain.

Severity of pain	No of patients	%	Post-operative Analgesia
Minimal	54	87	Tremadol 100mg single dose, Paracetamol tab.500mg t.i.d 4-7days
Moderate	8	13	Diclofenac Na 75mg 2 doses, Paracetamol tab.500mg t.i.d 4-7days
Severe(intractable)	0	0	0

Minimal pain: pain during rest, and dose not increase with movements, it is relieved by small dose of analgesia.

Table-7: Starting normal activities after surgery.

Return to normal activities(in days)	No. of Patients	%
3 rd post-operative	49	79
7 th post-operative	10	16
>7 days	3	5
Total Return	100	100

Fifty nine (95%) patients resume their day activities within 3-7 days, 3(5%) patients, required more time.

Forty two (91.3%) out of 46 patients who have light and heavy works, returns back to their previous jobs within 1-2 weeks after surgery. Four (8.7%) patients required more than two weeks, **table-8**. Regarding the post-operatively complications, (**table 9**) shows the early complications that occur within thirty days. While long term complications that occurs after thirty days, were presented in (**table 10**)

A surgical site infection, that requires antibiotics and local wound care, was noted in 3 patients

(4.8%).Urinary retention was noted in one (1.6%) patient with a recurrent inguinal hernia, required 4 days hospitalization . Prolonged pain for less than 1 month was noted in one patient, treated by None Steroidal Anti Inflammatory Drugs (NSAID).

Sensory loss at the upper thigh was noted in one patient and treated by NSID and physiotherapy. Sensory loss disappeared gradually within two months. Hyperesthesia on the upper thigh due to pressure on the (ilio-femoral nerve), was noted in 1 patient, it disappeared gradually; neither of the patient developed mesh-related problems (Infection, migration, adhesion, erosion, discharging sinuses) nor hernia recurrence in the long term of follow-up.

Table-8: The returns back of 46 worker patients to their previous jobs after inguinal mesh-plug repair.

Returns back to work (in weeks)	No. of patients	%
Within 1 st week	19	41.3
Within 2 nd week	23	50
> two weeks	4	8.7
Total	100	100

Table-9: Early post-operative complications (Less than 30 days)

Complications(< 30days)	No. of patients	%
Hematoma	4	6.5
Seroma	1	1.6
Surgical site infection (SSI)	3	4.8
Prolonged pain	1	1.6
Urinary retention	1	1.6
Sensory loss	1	1.6
Total	10	17.7

In this early postoperative period, severe pain, scrotal swelling, severe infection that needs re-admission and surgical removal of the mesh and deprement, did not occur in the present study.

Table-10: Late complications (more than 30 days):

Long-term complications(>30 days)	No. of patients	%
Mild pain (on exercise)	5	8
Sensory loss	1	1.6
Hyperesthesia	1	1.6
Total	7	11.2

Discussion:

With the growing number of articles and books, shows the efficacy and benefits of the mesh-plug hernioplasties^[10]. It is technically simple^[18], and can be used to repair all types of groin hernia (Gilbert's I-VII)^[4,10] and produce minimal post-operative pain^[19]. The open umbrella configuration can be easily handled and forms a total occlusion of the defect, the mesh –plug become completely infiltrated with fibroblast^[1]. The macroporus mesh, is preferred to allow infiltration of macrophages, fibroblast, collagen and factors of angiogenesis, pore size must be at least 75 microns to allow for this infiltration, smaller pore size would enable bacteria to pass where the macrophages and neutrophils cannot^[3]. The mesh plug is made in a form of a cone, (so called open umbrella) because closed umbrella will contract and can cause a "meshoma" that exert pressure on the nerve^[20]. which leads to chronic pain.

The patient would not expel the prosthesis or the hernial sac by coughing and straining; the prosthesis is held in place by intra-abdominal pressure^[19], preserving the hernial sac viable tissue, serve as a barrier between prosthesis and intraperitoneal contents, there by minimizing incidence of fistula and bowel obstruction. This technique patches the defect rather than close it by re-approximating fascia edges under tension^[21]

Studying the co-morbidity before operation, (table-3) has good etiological factor in raising intra-abdominal pressure^[22], in the pre-operative and along the post-operative period.

Success of groin hernia repair is measured primarily by the permanence of the operation with out recurrence, fewest complications, minimal costs, and earliest return to normal activities.^[23]

The post-operative pain was assessed depending on the patient compliant, and the need for using

analgesics to relieve postoperative pain (types, dose and duration of using analgesics) as in table-6, The assessment of pain was performed in the 1st post-operative day, 1st, 2nd, week, and after one month, then every 2 months and reviewed yearly for two years.

Pain in this study was significantly less than after Lichtenstein hernia repair^[24], while there is no significant difference with Prosthesis Hernia System [PHS] ® repair^[25], and it was not significantly less than after Trans Abdominal Pre Peritoneal (TAPP) repair^[26], while the post-operative pain in a patient undergoing Shouldice repair (tissue-repair) is prolonged and abstinence from normal activities and work for at least 6-8 weeks^[10]. This reflects the fact that open umbrella plug hernioplasty help to reduce post-operative morbidity and long-term discomfort. The repair entails much less dissection and traumatization.¹⁰ chronic pain can be successfully prevented by surgical technique^[11].

The convalescence time, is the time required for the patient to return to normal activities^[26], it is an important outcome parameter of hernia surgery^[27]. The median time to return for normal activities in the present study was 7 days. Important reasons for not resuming work and usual activities were pain (approximately 5 per cent of patients) and wound problems, like wound infection, Seroma, Hematoma, (approximately 12.9%). The technique of minimal manipulation, decrease numbers of stitching, will minimize post-operative pain and early return to work. While in the study of Chung and Rowland, the convalescence time was slightly longer in tension free than in TAPP or Totally Extra Peritoneal approach (TEP) (14 days versus 10days)^[26] the convalescence time in tissue repair needs 6-8 weeks^[23]

Other study from (15 eligible trials) 4005 participants, randomized or quasi- randomized trials comparing open mesh with open non-mesh methods to assess benefits and safety, shows short term pain and short hospitalization, return to usual activities was quicker in the mesh group for seven of ten trials, fewer recurrences in the mesh group (1.4%vs.4.4%)^[12].Also in 20 eligible trials(5018 participants) of open mesh vs. non-mesh groin hernia repair shows no clear difference between mesh and non- mesh groups in complications , but overall, those in mesh group had a shorter hospital stay, quicker return to usual activities and less frequent persisting pain ^[28] .

The time for return to work in the group having Lichtenstein operation was 28 days compared with 14days in the endoscopic group ^[29] .

6-8 weeks in Shouldice (Bholla Singh) ^[10] and 4-6 weeks in Bassini repair (Karen E. Deveney MD) ^[30] .14 days in the present study. Review **table-11**.

Although Wound infections is common^[31], and have been reported to occur in up to 15% of patient undergoing inguinal hernia repair and reduced to ten-fold (0.7%) after using prophylactic antibiotics^[32].In our study; surgical site infection (SSI) which is superficial infection was noted in 3 patients (4.8%), none of them required removal of the mesh, or readmission.

One month after Lichtenstein repair, thigh numbness was 8% but after 1 year it was 11% and 14% after laparoscopic repair ^[29] Sensory problems was recorded in the present study; in 2(3.2%) patients, one patient in the early post-operative complications and another patient in the long term

post-operative complications. Using the technique of cone (open umbrella) will decrease the incidence of contracted mesh or contracted plug, so called "meshoma" which may exert nerve pressure effect ^[20] .This technique will decrease the Sensory problems.

The recurrence was defined as a bulge or weakness in the operative area exacerbated by a Valsava maneuver and necessitating further operation or use of a truss ^[24]. In UK a government committee called National Institute for Clinical Excellence (NICE) re-examined the data on laparoscopic and open repair(2004 participants) fined the recurrence rate are identical^[33]

A retrospective comparison of 182 onlay mesh repairs and 170 Bassini repairs carried out by surgeons in training found 5 recurrences (3.3%) in mesh group, 13 (11.5%) in the Bassini group. Mesh –plug hernia repairs has resulted in a low recurrence rate with marked diminution of postoperative complications, it demonstrate the superiority of open mesh plug repair to other hernioplasties ^[1].A study done randomly on (595) patients for one year ,revealed no significant differences with respect to recurrence rate or immediate postoperative complications in Lichtenstein or mesh-plug repair ^[34].Also a review of 20 eligible trials(5016 participants) of open mesh vs. non- mesh groin hernia repair , provides strong evidence that open mesh repair is associated with a reduction in the risk of recurrence of between 50% and 75% with evidence of quicker recovery and lower pain ^[35] .

Table-11 Summary of the results in other studies, regarding the Technique employed, pain, complication, Recovery, Recurrence rate, and the results of the present study.

Study Authors	Technique Employed	No. Patient	Op. time (min)	Pain	Complication (Total)	Recovery (days)	Recurrence
Isemer FE ¹⁸ et al 2004	MPR	766	37.8	3.3%	9.1%	6.54	1.8%
Sven Bringman ²⁴ et al 2003	TEP [‡]	92	50	3(3.3%)	9(9.8%)	5	2(2.2%)
	MPR	104	36	4(3.8%)	10(9.6%)	7	2(1.9%)
	Lichtenstein	103	45	10(9.7%)	15(14.6%)	7	—
S.W Nienhuijs ²⁵ et al, 2004	PHS *	111	—	More			1(0.9%)
	MPR	113		Less			4(3.5%)
	Lichtenstein	110		More			3(2.7%)
Prof.A.Gra ³⁵ 2000	Mesh	1573		Less		quicker	21(1.4%)
	Non-mesh	1634		More			72(4.4%)
Bholla Singh et al ¹⁰ , 2003	Mesh	50	37	Less	10%	7	0
	Shouldice	50	56	More	16%	6-8 wks	0.2%
KE. Deveney MD ³⁰ , 2003	Bassini repair	—	—	More		4-6 wks	1-28%
Al-Yermouk 2009	MPR [†]	62	36	5(8%)	7(11.2%)	7	0

[†] MPR; mesh plug repair, [‡]TEP; totally extra peritoneal repair, * PHS; prosthesis hernia system repair

Conclusion:

Mesh plug repair appears to be easy, simple, efficient and quick procedure, it has less operative

and postoperative morbidity, it is superior to the tissue repair groin hernia in regards to post

operative pain, short hospital stay, early return to normal activities, and decrease recurrence.

One of the problems in inguinal hernia research is that the patients must be followed for a significant period to evaluate the recurrence rate and the late postoperative morbidity, so we need: Longer period of observation and follow up to evaluate the results, larger number of patients, Expansion of the study to include, many surgeons and different methods of hernia repair (laparoscopic repair, open mesh repair (Lichtenstein) and open non- mesh repair) is recommended.

References:

- 1-Alan W. Robbins MD, and Ira M. Rutkow, MD, MPH, DrPH. Mesh plugs Repair and Groin Hernia Surgery. Surgical clinics of North America. 1998; 78(6) :1007-27.
- 2- Nathan JD, Pappas TN "Inguinal hernia: an old condition with new solutions. Ann Surg.2003; 238 (6 Suppl) :S148-57
- 3-Robyn Mitchell Gardener, MHE,PA-C ;Carl R. Boyd MD, FACS. "Examining modern approaches to inguinal and femoral herniorrhaphy" JAAPA. 2008; June 01,
- 4-Fasih T; Mahapatra TK; Waddington RT; " Early results of inguinal hernia repair by the 'mesh plug' technique-first 200 cases ". Ann R Coll Surg Engl.2000;82(6):396-400.
- 5-Holzheimer RG; "First results of Lichtenstein hernia repair with Ultrapro-mesh as cost saving procedure—quality control combined with a modified quality of life questionnaire (SF-36) in a series of ambulatory operated patients. Eur J Med Res. 2004; Jun 30;9(6):323
- 6- Post S, Weiss B, Willer M et al Randomized clinical trial of lightweight composite mesh for Lichtenstein inguinal hernia repair. . Br J Surg 2004; 91: 44-48.
- 7-Scott NW, McCormack K, Graham P, Go PM, Ross SJ, Grant AM " Open mesh versus non-mesh for repair of femoral and inguinal hernia". Cochrane Database Syst Rev. 2002;(4):CD002197.
- 8- The MRC Laparoscopic Groin Hernia Trial Group " Laparoscopic versus open repair of groin hernia: a trobe zed comparison.". Lancet 1999; 354: 185-190.
- 9- Vrijland W W, van den Tol M P, Luijendijk R W et al Randomized clinical trial of non-mesh versus mesh repair of primary inguinal hernia. . Br J Surg 2002; 89: 293-297
- 10- Bholla Singhu, Ranpinder Kaur Sidhu."Tension-free open mesh plug repair versus Shouldice repair under local anesthesia in groin hernia"Indian Journal of Surgery. 2003; 65(2):163-167.
- 11- Holzheimer RG "Low recurrence rate in hernia repair-results in 300 patients with open mesh repair of primary inguinal hernia". Eur J Med Res. 2007 Jan 31;12(1):1-5.

- 12- Professor A. Grant, EU, Hernia Trialists Collaborations "Mesh compared with non- mesh methods of open groin hernia repair" Systematic review of randomized controlled trials. Br. J. Surg. 2000; 87(7) .854 -9.

- 13- Arvidsson D, Berndsen F H, Larsson L G et al. "Randomized clinical trial comparing 5-year recurrence rate after laparoscopic versus Shouldice repair of inguinal hernia". Br J Surg 2005; 92: 1085-1091.

- 14- Mohan P Desarda "No-mesh inguinal hernia repair with continuous absorbable sutures: A dream or reality. The Saudi Journal of Gastroenterology. Vol, 2008; 14(3): 122 – 127.

- 15- Bringman S, Wollert S, Osterberg J et al " Three-year results of a trobe zed clinical trial of lightweight or standard polypropylene mesh in Lichtenstein repair of primary inguinal hernia." . Br J Surg 2006; 93: 1056-1059

- 16- Elsebae MM, Nasr M, Said M " Tension-free repair versus Bassini technique for strangulated inguinal hernia: A controlled randomized study ". Int J Surg. 2008; 6(4):302-5.

- 17- Neumayer L, Giobbie-Hurder A, Jonasson O, Robert Fitzgibbons, Jr., MD Dorthy Dunlop, PhD, James Gibbs, PhD, Domenic Reda, PhD., and William Henderson, PhD., Open mesh versus laparoscopic mesh repair of inguinal hernia. N Engl J Med 2004; 350: 1819- 1827

- 18- Isemer FE, Dathe V, Peschka B, Heinze R, Radke A " Rutkow PerFix-plug repair for primary and recurrent inguinal hernias-a prospective study" Surg Technol Int. 2004;12:129-36

- 19- George E.Wantz, MD. Open repair of Hernias of the abdominal wall. ACS. Surgery, principles and practice; webMD Inc. 2003 chap. 20 p.872.

- 20- Hernia Center of Southern California. Surgical Techniques. Pasadena 2006 (web.).

- 21-GeorgeH.Sakorafas,MD, Christos Nissiotakis, MD., Joannischalikias, MD., Nikolaos Kotsifopoulos, MD., Alexios Stavrou, MD., and George A. Kasseris, MD " Open preperitoneal Mesh Repair of Recurrent Inguinal and Femoral Hernias" The Mount Saint Journal of Medicine. 2005;. 72 (5):344

- 22- Andrew N. Kingsnorth, Giorgi Giorgobiani and David H. Benett; Hernias, Umbilicus and abdominal wall; Bailey and Loves Short practice of surgery, HODDER ARNOLD 25th Ed. 2008; 57:968

- 23- Milić DJ, Pejić MA "Tension-free procedures in the surgical treatment of groin hernias" Srp Arh Celok Lek. 2003; 131(1-2):82-91.

- 24- Sven Bringman, MD, Stig Ramel, MD, PhD, Timo-Jaako Heikkinen, MD, PhD,. Tord Englund, MD, Bo Westman MD, Bo Anderberg, MD, PhD "Tension –free inguinal hernia repair: TEP versus Mesh – plug versus Lichtenstein. A prospective

Randomized controlled Trial ". Ann Surg. January; 237 (1) 142-147.

25- S.W Nienhuijs, I.van Oort, M.E. Keemers-Gels, L.J.A. strobbe and C.Rosman. Randomized clinical trial comparing the Prolene Hernia System, Mesh plug repair and Lichtenstein method for open inguinal hernia repair. British journal of Surgery. 2005; 92:33-38.

26-.Liane S. Feldman, MD. And Marvin J. Wexler, MD." Laparoscopic Hernia repair "ACS .S Principles and Practice; webMDInc. 2003. chap. 21 p. 896

27- M Bay-Nielsen, H Thomsen, F Heidemann Andersen, JHBendix, OK Sorensen, N S Kovgaard, H Kehley." Convalescence after inguinal Herniorrhaphy". Br J Surg. 2000; 87 (7):860-7

28-Grant AM; EU. Hernia Trialists Collaboration." Open Mesh versus non-mesh repair of groin hernia: meta-analysis of randomized trials based on individual patient data (corrected). Hernia 2002; 6 (3):130-6 Epub 2002 Jul 26

29- Martin Kurzer, FRCS, Philip A. Belsham, FRCS, and Allan E. Kark FRCS, FACS. "The Lichtenstein repair ". Surgical clinics of Northern America; Vol.78. No. 6 Dec.1998. Pp.1025-1045.

30- Karen E. Deveney MD; Hernias and other lesions of the abdominal wall; current surgical diagnosis and treatment ; 11th edition.2003; chapter 33 :. 783-88.

31-Taylor E W, Duffy K, Lee K et al. "Surgical site infection after groin hernia repair". Br J Surg 2004; 91: 105-111

32-.Yerdel M A, Akin E B, Dolalan S "Effect of single-does prophylactic ampicillin and sulbactam on wound infection after tension-free inguinal hernia repair with a polypropylene mesh. Ann Surg 2001; 233: 26-33.

33- Herniorrhaphy, from wikipedia. The free encyclopedia.

34- Albert B. Lowenfels, MD. "Lichtenstein or Mesh Plug Hernia Repair, is there a Difference in Recurrence ? " Medscape General Surgery © 2007.

35. Collaboration EH. "Mesh compared with non-mesh methods of open groin hernia systematic review of randomized controlled trials. Br J Surg. 2000; 87(7):854-9.

Department of Surgery, Al- Yermouk Teaching Hospital