

**Combined plastic of the posterior wall of inguinal canal with a mesh implant and aponeurosis of the external oblique abdominal muscle**

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**Abstract**

**Background:** Back in the days all surgical procedures for restoration of hernial defects was to suture the tissues unfortunately, most of those techniques were associated with high recurrence rates. The recurrence of the hernias continued to pose difficulty of the hernial surgeries for decades, until the synthetic mesh implant was introduced in the 1940s. However, one of the disadvantages of the inguinal canal plastics with a mesh implant is cicatricial changes in the structures of the spermatic cord at the place of its contact with the mesh, even though the scar formation reinforced and strengthened the defect. Apart from these cicatricial changes there have also been many adverse effects reported, some of which includes chronic pain, infections and adhesions leading to bowel obstruction, fistula and perforation formations. However, all surgical techniques with implantation of a foreign

body do has its benefits and risks. Moreover, this method proposed reduces the risk of development of these complications, hence is recommended to practice more often nowadays.

**Purpose:** Strengthening of the posterior wall of the inguinal canal by using tension free plastics in patients with inguinal hernias.

**Operation technique:** A technique was developed to repair the inguinal canal with a combined plastic of the posterior wall of the inguinal canal with a polypropylene mesh and an aponeurosis of the external oblique abdominal muscle. The mesh implant is fixed on the posterior wall of the inguinal canal. In the upper flap of the aponeurosis, an incision was made parallel to its lower edge. The aponeurotic canal will be formed after fixing the lower edge of the aponeurosis to the inguinal ligament.

Results and its discussion. As a benefit of the developed operation, both the mesh implant and the aponeurosis of the external oblique abdominal muscle reinforces the posterior wall of the canal. Due to the fact that the spermatic cord is situated on the aponeurosis and not on the mesh, (which is physiological) it prevents the development of fibrous processes in the spermatic cord. All patients were discharged from the hospital on the 6th day in a satisfactory condition.

### **Findings**

1. The results of the developed operation for inguinal hernia indicate the absence of clinically significant complications in the early postoperative period.
2. In this proposed operation, the consequences were avoided as the spermatic cord lies in the aponeurotic canal.

**Keywords:** Hernioplasty, Inguinal hernia, Liechtenstein, Trans inguinal pre-peritoneal (TIPP), Totally extra-peritoneal (TEP), Trans abdominal preperitoneal repair (TAPP)

### **Introduction**

According to various authors and literature it was concluded that approximately 47% of the population were affected by anterior abdominal wall hernias. [1]. So far, the most frequently performed surgeries globally are hernioplasty and inguinal hernia repair which takes up around 10-21% of all surgeries which are performed in general surgical hospitals. For example, more than 700 000 hernia repairs are performed annually in the USA, 200 000 in Russia, 110 000 in France and 80 000 in the UK and about 1000 inguinal hernia operations in Grodno region [2,3]. Most of the inguinal repair surgeries were performed in males due to the fact that 60% of working population are affected. A greater proportion of relapses after surgery and acceleration of giant inguinal-scrotal

and recurrent hernias (from 2-5% with primary hernia repair & 10-15% with repeated operations), justify the discussion among herniologists worldwide about a most rational method of surgery.

The treatment of choice in inguinal hernia is the strengthening of the posterior wall of the inguinal canal and it is a necessity in modern herniologists as well. The classic methods of strengthening the posterior wall are using muscle (Bassini repair), fascial tendon (Kukudzhanov's method) and aponeurotic tissues (Postemsky and Kimbarovsky) which do not allow connecting the upper and lower flaps of the inguinal canal without a tension and with a large inguinal interval. These methods of hernioplasty can lead to rupture of the inguinal ligament, and due to the heterogeneity of the sutured tissues it forms a weak scar at the 1<sup>st</sup> row of sutures, which can lead to the disruption of the anatomy and physiology of the structures in the inguinal canal.

Therefore, plastic surgery using a polypropylene mesh is currently the main method of surgical treatment of inguinal hernias. The technique of inguinal hernia repair, proposed by Lichtenstein, was recognized once as the "gold standard" in the treatment of inguinal hernia due its reliability, simplicity and speed. In February 1989, Tension-free plastics of the posterior wall of the inguinal canal with a mesh polypropylene endoprosthesis was originally published by the author. Long term positive results (0.1% recurrences) gained international attention and approved by surgeons worldwide. According to foreign literature, using the Lichtenstein operation has only 0.2-7% recurrence of primary hernias and about 2% in recurrent ones [4].

The Lichtenstein plasty is popular among surgeons due to its benefits such as tension-free nature, the absence of a muscle-tendon connection and high reliability in terms of

recurrence. However, due to the possible risk of infection of the mesh, this method of operation is very limitedly used for strangulated hernias and also in recurrent hernias, the operation has technical difficulties at the stage of selecting a sight for mesh fixation [5]. Lichtenstein plasty also requires a special suture material, similar to the composition of a mesh implant and specific postoperative complications occurred due to implantation of artificial mesh which includes: stiffness and discomfort at the operated site, sensation of a foreign body, and local chronic infection due to inappropriate selection of endoprosthesis. Inflammation of the tissues around the implanted mesh (as a reaction of the body to a foreign body) can lead to the formation of so-called "gray" (tumor-like accumulations of serum in the tissues) or mesh migration with recurrent hernia. If the endoprosthesis becomes infected in the recovery period, fistulas may develop, which can lead to mesh rejection or infection, which may require detachment of the mesh implant [6].

Major drawback of Lichtenstein plasty is the spermatic cord lying on the mesh which leads to cicatricial changes in that can subsequently lead to disruption of the circulation to the tissues of the testicle, its atrophy and disruption of its endocrine function, this may also involve the vas deferens which can lead to sexual impairment in the recovery period [7].

These features of Lichtenstein hernioplasty prompted us to develop our own modification of tension-free surgery for inguinal hernia, which can protect the spermatic cord from the negative impact of the mesh implant on it.

### **Target**

Development of non-tensioning plastic surgery of the posterior wall of the inguinal canal in patients with

inguinal hernias for the prevention of dysfunction of the elements of the spermatic cord.

### **Operation technique**

As stated by the Health Care Institution «Grodno University Clinic», a technique for the restoration of inguinal hernia was developed which entails combined plasty of the posterior wall of the inguinal canal with a polypropylene mesh and aponeurosis of the external oblique muscle of the abdomen. The proposed operation avoids possible undesirable changes in the spermatic cord associated with the contact of the cord and mesh implant. This approach of tension free hernioplasty was performed on 10 patients with unilateral primary inguinal hernias. The operation was mainly targeted and performed on the male population aged 35 to 67 years, among which 7 of them had canal hernias and 3 had inguinal-scrotal hernias. The term of hernia carriage varied from 2 months to 6 years, the size of the hernia ring ranges between 3 to 7 cm in diameter. All patients approved for operation were hospitalized as planned. The operation technique was given consent by the ethics committee at the Grodno University Clinic (minutes of the commission meeting No. 4 dated March 13, 2018).

The operation was performed under spinal anesthesia. After a layer-by-layer opening of the inguinal canal, the hernial sac was isolated, processed and removed according to the generally accepted method with immersion of the tip of the sac into the abdominal cavity according to Krasintsev-Barker. In the first stage according to Ioffe the transverse fascia was sutured in order to strengthen the posterior wall of the inguinal canal by shortening the length of the deep inguinal ring to its normal anatomical size in. At the second stage, the implanted mesh is cut according to the size of the inguinal gap with the formation of a hole for the spermatic cord

which was fixed at 4 points at its corners. This prevented it from shirring. From below, the mesh was fixed with an interrupted suture medially to the pubic tubercle and with a twist suture from the lateral angle of the mesh to the inguinal ligament along the projection of the deep inguinal ring medially onto the Poupart's ligament (Inguinal ligament). From above, the mesh was fixed with to the internal oblique and transverse muscles with the sheath of the rectus abdominis muscle medially by using interrupted sutures.

At a distance corresponding to the width of the spermatic cord (average 2 cm), from the edge of the upper flap of the aponeurosis, an incision was made parallel to the same edge 1 cm lateral to the projection of the pubic tubercle with the formation of an aponeurosis strip sectioned in to two halves. (Fig. 1).

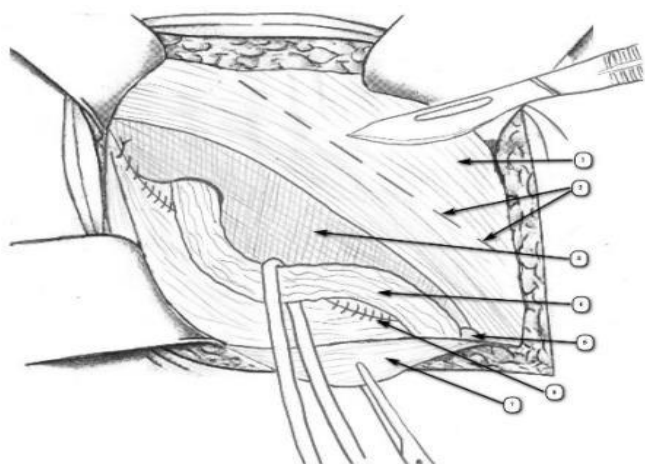


Figure 1: It depicts the plastics of the inguinal canal and the aponeurosis of external oblique muscle along with mesh implantation. It shows the implantation of the mesh to the Poupart's ligament and internal oblique and transverse muscles.

- 1 - The upper appendage of the fascia of the external oblique muscles;
- 2 - Incision line on the upper appendage of the fascia of the external oblique muscle of the abdomen to form a strip of aponeurosis on the legs;

- 3 - Implantation of the mesh;
- 4 - Spermatic cord;
- 5 - The pubic tubercle;
- 6 - Line of sutures between the inguinal ligament and the lower edge of the implanted mesh; 7 - lower flap of the fascia of the external oblique abdominal muscles.

The lower edge of this formed strip of the fascia of the external oblique muscle of the abdomen was sutured to the Poupart ligament together with the lower edge of the mesh from the pubic tubercle along the projection of the inner edge of the deep inguinal ring. At the same time, the strip remained attached to the aponeurosis with the help of legs in its medial and lateral ends, from below - with the Poupart's ligament and from above, its edge was fixed with a twisting suture to the underlying mesh and the internal oblique and transverse abdominal muscles. Thus, at the third stage of the plasty, a "new" aponeurotic canal of the posterior wall was formed, reinforced from below with a mesh implant (Fig. 2).

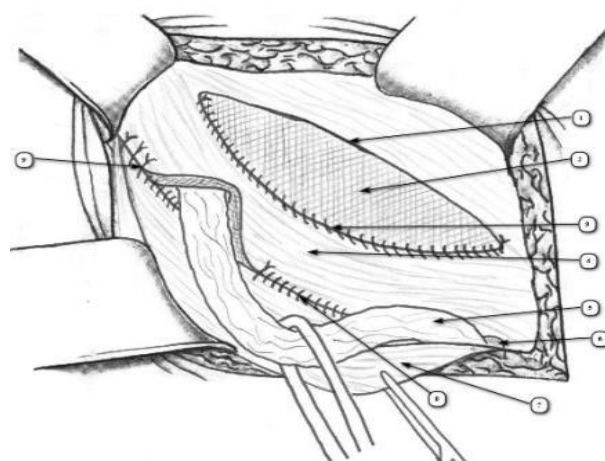


Figure 2: It depicts the plastics of the inguinal canal and the fascia of external oblique muscle. Further it shows the beneath boundary of the aponeurotic strip together with the underlying boundary of the mesh being attached to the inguinal ligament, and then the upper border of this strip is fixed to the underlying mesh and the internal oblique and transverse muscles of the abdomen.

- 1 - Free edge of the aponeurosis of the external oblique muscles;
- 2 - Implantation of the mesh on the posterior wall of the inguinal canal;
- 3 - The line of sutures connecting the upper border of the formed aponeurosis strips on the legs and the underlying mesh, the internal oblique and transverse muscles;
- 4 - Formed strip of the fascia of the external oblique abdominal muscles on the legs;
- 5 - Seminal cord;
- 6 - The pubic tubercle;
- 7 - The lower flap of the aponeurosis of the external oblique muscles;
- 8 - The line of sutures between the inguinal ligament, the lower edge of the implanted mesh and the underlying boundary of the formed strip of the aponeurosis of the external oblique abdominal muscle on the legs medial to the deep inguinal ring;
- 9 - The line of sutures between the Poupart ligament, the lower border of the implanted mesh and the underlying boundary of the formed aponeurosis strip of the external oblique abdominal muscle on the lateral legs.

In the above-mentioned operation, the spermatic cord does not lie on the mesh, as in Liechtenstein plastic surgery, but instead lie on the fascia of the external oblique muscle. Hence, it prevents the development of postoperative complications of hernioplasty associated with the contact of the funiculus and the underlying mesh. The unused part of the free edge of the upper aponeurosis flap, surrounding the funiculus at the place of its exit from the deep inguinal ring, was sutured to the Poupart's ligament laterally to the place of its divergence from the lower aponeurosis appendage by using continuous suture. This phase of the operation is vital in the prevention of

recurrence, as recurrence of such hernias frequently occurs laterally to the deep inguinal ring, as well as in the prevention of strangulation of the funiculus in the inguinal ring, hence a diameter of 0.9 - 1.0cm should be maintained.

The spermatic cord was placed on an aponeurotic strip attached to a mesh. Above the funiculus, the lower aponeurotic flap and the free edge were sutured end-to-end with a twisting suture towards the pubic tubercle with the formation of a superficial inguinal ring. In this way, an "aponeurotic tunnel" was formed for the spermatic cord.

### **Results**

The above suggested method of tension-free hernioplasty has a number of benefits, some of which includes: the restoration of the posterior wall of the inguinal canal by both the implantation of the mesh and its aponeurosis, furthermore, the funiculus also lies on the aponeurosis, and not on the underlying mesh. The site where the cord lies with the implanted mesh is physiological, hence it excludes the development of possible fibrous processes likely to occur in the structures of the spermatic cord along with prevention of violation of its subsequent functions. Due to the slit-like shape of the deep inguinal ring formed during the operation, reinforced with Ioffe transverse fascia plasty, as well as the suturing of the upper free border of the aponeurosis of the external oblique muscle with the Poupart ligament and the underlying boundary of the mesh lateral to the deep inguinal ring provides prevention against recurrence of such hernias.

The surgery was performed within a time frame ranging from 50-90mins. In the recovery period, there was no necessity in the introduction of narcotic analgesics since patients didn't experience severe pain. During

examination edema and hematomas were not noticed in the wound site, it was noticed that the testicle on the side of the hernia remained in its normal anatomical size from the beginning of the 1st day, and also was painless on palpation. As reported by the patients, none of them complained of any discomfort in the groin region and no complaints of "tingling" sensation of a foreign body in the projection of the inguinal canal when walking, at rest and along with maximum flexion in the hip joint were reported. Primary wound healing was observed in all patients after dressings. Moreover, complications as hematomas and infectious complications were not observed, hence, the sutures were removed on the 6th day. There were no any further changes of the mesh graft observed in the early postoperative period.

All the patients were dispensed from the hospital on the 6th day after the intervention and physical activity was allowed after 10th day.

### **Discussion**

Worldwide, there are many strategies for hernia repair with mesh repair currently being used more frequently; with 0-5% of these occurring in specialist centers with low resources and 95% being performed in those centers with high resources. However, there are surgeons and certain specialized centers that encourage the use of non-mesh repair in those patients with low risk of recurrences. Presently, a great deal of non-invasive procedures is being performed in countries with considerable resources for instance, in Australia (55%), Switzerland (40%), Netherlands (45%) and Sweden (28%).[8]

The international hernia societies have declared evidence-based guidelines to enhance the results of inguinal hernia repair. The new international guidelines of the hernia surge group with representatives of all continental hernia societies only approved the open mesh

Lichtenstein technique and the laparo-endoscopic mesh techniques TEP and TAPP.[9]

Current inguinal hernia repair techniques include: non-mesh techniques which includes Shouldice, Bassini and Desarda; Open mesh techniques which includes Lichtenstein, trans inguinal preperitoneal (TIPP), trans rectal pre-peritoneal (TREPP) and plug and patch; And also, the endoscopic techniques which includes totally extra-peritoneal (TAP), trans abdominal pre-peritoneal repair (TAPP), surgical incision laparoscopic repair (SILS) and robotic repair.

Techniques appropriate for the situations listed below:[10] Primary unilateral (as well as in bilateral cases) inguinal hernia- TAP Lichtenstein, recurrent inguinal hernia- after previous laparoscopic procedure should be repaired in the Lichtenstein technique, and previous open repair procedures should be repaired with laparoscopic technique, scrotal hernia- Lichtenstein technique, with a history pelvic or lower abdominal operation- open mesh Lichtenstein technique, in patients with serious cardiac/pulmonary complications- Lichtenstein technique and in emergency repair (without contamination)- Lichtenstein or laparoscopic technique (current concepts).

The traditional tension repair does not pose any risk related to implantation of foreign body, nevertheless it is not often practiced now due to its high recurrence rate and slow rehabilitation. Whether the surgery being performed open or laparoscopic is completely decided by the surgeon. The synthetic mesh used here to close the hernial defect, induces the body's inflammatory response which inaugurates the tissue growth around the mesh creating a strong wall and hence, this provides the benefit of low recurrence rate. Furthermore, to name a few of the other benefits of tension free plasty over conventional

method includes:[11] minimal analgesic requirements, lower percentage of complication rate, short hospital stays, lower recurrence rate and ability to return to work within a few days.

However, the technique of operation is decided by the surgeon and it usually depends on three factors, among which includes: the patient: the tissues solidity and the tension to which the tissues are submitted, the hernia: the technique varies from small inguinal hernias to major complicated hernias which usually has an increased frequency rate and the surgeon: this usually depends mostly on the experience and the specialization.

In 1887 the method proposed by Bassini, showed a repetition of approximately 10-15% per annum from several countries according to the statistics presented; including some other techniques like the Shouldice and others among which do not use mesh in plasty. The method of Lichtenstein is practiced nowadays according to the modern concepts. This method provides some added advantages compared to the non-mesh methods as it's a simple technique with postoperative complications experienced to a lesser extent including chronic pain, ability for working capacity is faster along with the added benefit of the ability of this technique being performed under local anesthesia. As known, the mesh implant rate has expanded from 7% in 1992 to 15% in 1996 in Sweden especially. According to a recent meta-analysis issued by Scott N.W. at the Cochrane library which mainly focused on the comparisons between the mesh and the non-mesh techniques with the help of 12 randomized clinical trials, showed that the recurrence rate in hernioplasty with mesh was lesser than those without the use of mesh by approximately 40 times. Furthermore, with reduced post-operative complications including, reduced or minimal postoperative pain, lower doses of analgesics, lower

occurrence of seroma and hematoma along with lower infection rate and a shorter time required for the surgery to be performed tension-free hernioplasty with mesh seems to be a better surgical technique. [11,12]

In general, majority of herniorrhaphy failures is due to the suturing technique of the placement of the structures, however the use of mesh has resolved this problem with the possibility of the repair to be performed without the disruption of the normal anatomy and with no suture line tension. [12]

Even though, tension-free hernioplasty has many additional benefits it also has some contraindications;[13] the absolute contraindications which include: allergy to prosthetic mesh, a perforated bowel and age below 18 years. Strangulated hernia is one of the relative contraindications.

However, according to this study the tension-free hernioplasty is the preferred method due to its safe, inexpensive, economical and patient satisfaction postoperatively.

### **Conclusion**

According to the results obtained, we have drawn to a conclusion that in the early recovery period, the plasty of the posterior wall of the inguinal canal with a mesh and aponeurosis of external oblique muscle prevents the development of any significant complications. The proposed modification of the operation allows to preserve the advantages of inguinal canal plastic surgery with a mesh implant and also to avoid the negative effect of the mesh on the spermatic cord due to the conclusion of the latter in the "aponeurotic tunnel". The results revealed significantly enhanced well-being in the more advanced stages of the post-operative period. This above-mentioned method developed for strengthening of the inguinal canal which is based on the principle of "no tension" has an

increased potential in the surgical repair of hernias as it excludes all the complications associated with the use of synthetic material. This technique also avoids contact with the nerves and hence lowers the possibility of neuralgia and the sensation of foreign material.

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