



Open anterior groin hernia repair

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Abstract: Inguinal hernia repair is one of the more common surgical procedures done by a general surgeon. This review article discusses the different open anterior approach for groin hernia repair. From its history and evolution, the management of groin hernias has evolved from the tissue repairs of Bassini and Shouldice to the prosthetic repairs of which the Lichtenstein technique is the most popular. This review also includes recommendations from the guidelines of the European Hernia Society and the Asia Pacific Hernia Society.

Keywords: Inguinal hernia; prosthetic material; Shouldice; Lichtenstein

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Introduction

Inguinal hernia is one of the more common surgical procedure performed by general surgeons. In population-based studies reported by the Asia Pacific Hernia Society, hernias afflict 15–20% of the population (1).

Inguinal hernias have three types. Indirect hernias were the hernia sac comes out lateral to the deep epigastric vessels through the internal ring and follows the course of the spermatic cord. Direct hernias were the hernia sac comes out medial to the epigastric vessels; at the floor of the groin and femoral hernias, which comes out at the femoral ring.

All inguinal hernias will require surgical repair. There are different options for surgical repair. It may be utilizing the musculoaponeurotic layers of the abdominal wall or use prosthetic materials to strengthen the floor. In this review article, only the open approaches will be discussed.

History and evolution

The history of groin surgery dates back as far as 1550 BC when the famous Ebers papyrus mentions about patients suffering from inguinal hernia. From that time up to the 17th century, inguinal hernias has been recognized as a surgical problem and management ranges from taxis to

reduce the hernia, application of ligatures to secure the sac and applying heat and chemical agents to cause scarring and fibrosis. Majority of these procedures require castration to secure the hernia from within the abdominal cavity. During the 18th to 19th century, anatomical studies were extensive where details of the groin were delineated (2). This brought about modifications in the management of groin hernias. The 20th century brought about developments in anesthesia and antisepsis as introduced by Lister and Morton (3,4). This development allowed better dissection of the groin with evolution of better techniques in inguinal hernia management. This era ushered in the advent of modern hernia surgery.

Key anatomic structures

Anatomy is very important in groin hernia repair. It is mandatory for a surgeon operating on hernias to have a clear understanding of the anatomy of the groin. Expert knowledge of the key anatomic structures is important whether the surgeon will do a tissue or prosthetic repair. Clear understanding of the anatomy will translate to excellent dissection that is also a requirement for excellent groin hernia repair. The key anatomic structures are:

- (I) External oblique aponeurosis;
- (II) Internal oblique muscle;

- (III) Transversus abdominis muscle;
- (IV) Inguinal ligament;
- (V) Internal and external ring;
- (VI) Spermatic vessels and vas deferens;
- (VII) Nerves: ilioinguinal, iliohypogastric, genital nerve.

External oblique aponeurosis: this aponeurosis arises from the external oblique muscle. It acts as the roof of the inguinal area. The external ring is formed by this aponeurosis. Laterally, it folds on itself to form the inguinal ligament. The inguinal ligament is attached to the anterior superior iliac spine and the pubic tubercle. The inguinal ligament is a key anatomic structure where aponeurotic tissues are sutured or where prosthetic materials are anchored for groin hernia repair (5,6).

Internal oblique muscle: the internal oblique muscle is the muscular layer under the external oblique. At the level of the groin, the internal oblique arches over the spermatic cord to form the superficial part of the internal ring. Together with the transversus abdominis, it composes the internal ring at the level of the transversalis fascia. It also envelops the spermatic cord as the cremasteric muscle. The cremaster muscle is preserved during groin surgery to protect the spermatic vessels and the vas deferens (5).

Transversus abdominis muscle: the transversus is the next layer after the internal oblique. It is theorized that it forms the aponeurotic arch. With the contraction of the transversus abdominis, the arch moves downward to the inguinal ligament and this constitutes the shutter mechanism of the groin. Some authors believe that if the arch is high, this predisposes the patient for the development of a direct hernia (5).

Anterior nerves of the Groin

There are three nerves that need to be identified during open anterior groin surgery. They are the iliohypogastric nerve, the ilioinguinal nerve and the genital nerve. The ilioinguinal and iliohypogastric nerve arises from the first lumbar nerve. They divide either at the level of the psoas muscle or at the level between the internal oblique and transversus abdominis muscle. At the level of the groin the ilioinguinal nerve follows the course of the spermatic cord while the iliohypogastric nerve penetrates the external oblique muscle to innervate the skin above the pubis. The genital nerve lies within the cord inferiorly and is identified by the blue line or the blue external spermatic vein. The genital nerve lies superior to the blue line (7). It is

important to identify all three nerves during groin surgery to avoid chronic inguinal pain.

Indications for repair

When inguinal hernia is diagnosed, surgical options have to be discussed. There are no other forms of treatment for inguinal hernia except surgery. Robert Fitzgibbons published the role of watchful waiting for asymptomatic or minimally symptomatic hernia. His finding showed that these types of hernias could be observed until they become symptomatic before undergoing surgery. This finding was collaborated by the publication of O'dwyer also in 2006 (8,9). The European Hernia Society (EHS) came up with guidelines in groin hernia management. The 2014 guidelines concluded that watchful waiting is safe but in time more than 70% of the cases will require surgery. A follow-up study of O'dwyer [2011] noted that with longer observation time, there is a higher crossover rate to surgery for the patients who were observed (10,11). The Asia Pacific Hernia Society (APHS) also came up with their recommendation with regards to watchful waiting. APHS 2014 guidelines recommend that watchful waiting may be an option but the surgeon has to consider several factors such as the patient's lifestyle, socioeconomic background and access to a healthcare facility. It is recommended that surgical treatment have to be offered since these asymptomatic patients will develop symptoms over time (1). In incarcerated cases where strangulation is suspected, immediate surgery is recommended.

Types of repair

There are different options for the surgical management of inguinal hernias. Since the introduction of the radical cure for hernia by Bassini in the eighteenth century, the surgical management of inguinal hernia has developed and several authors have pioneered several techniques in managing this problem. The different open anterior repairs can be classified into tissue repairs and prosthetic repairs.

Tissue repair

There were several tissue repairs proposed throughout the evolution of hernia surgery. A lot of the proposed repairs had non-satisfactory results. Eduardo Bassini was the first to report excellent results with his new technique for the radical cure of hernia. In this review only the Bassini

technique and the Shouldice technique will be reviewed.

Bassini repair

The Bassini repair aims to reconstruct the posterior wall of the inguinal canal and do high ligation of the hernia sac. For a thorough dissection of the hernia sac, the internal oblique, transversus abdominis and the transversalis fascia are divided. This will facilitate entry into the pre-peritoneal space. The hernia sac is then dissected free of the spermatic cord and ligated at the level of the iliac fossa to facilitate high ligation of the sac. Lembert sutures are then placed at the cut edges of the three layers of the abdominal fascia and imbricated to the inguinal ligament. This will require 6–8 sutures to complete the procedure. The last lateral stitch extends 1 cm beyond the internal ring to maximize the obliquity of the repair. With this technique, Bassini reported a recurrence rate of 2.7% and a wound infection rate of 5% with a follow up of 4.5 years (12). Due to the success of Bassini several surgeons adapted his technique and introduced their own modifications. This resulted in the corruption of the technique with results, which are not comparable with that of Bassini's. This brought about the downfall of the Bassini technique (2,5).

Shouldice technique

Dr. Edward Earle Shouldice first described the Shouldice technique in 1945 (13). It follows the initial steps of Bassini, from incision, mobilization of the cord structures, division of the cremaster muscle, division of the posterior wall of the inguinal canal up to the management of the hernia sac. The floor is reconstructed in a different manner. The floor is reconstructed with a continuous stainless steel wire with four lines of repair thereby reinforcing the floor (14). Since then the Shouldice technique has been proven to be the best tissue repair for groin hernias. Glasgow in 1986 reported a less than 1% recurrence for more than 20,000 repairs in a 30-year period. A systematic review published by Simons in 1996 showed a recurrence rate of 0.7–1.7% for hernia specialty centers and 1.7–15% for non-hernia specialty centers. This data shows that the Shouldice technique is not easily reproducible if the surgeon is not properly trained or a specialist in the Shouldice technique. A Cochrane database systematic review done by Amato in 2012 which included 16 trials and 2,566 hernias showed that comparing Shouldice versus mesh repairs, the Shouldice technique has a higher recurrence (OR: 3.80; 95% CI: 1.99 to 7.26). However,

recurrences in the Shouldice technique in comparison to non-mesh techniques showed a lower recurrence for Shouldice (OR 0.62; 95% CI: 0.45 to 0.85) (15-17). It is also recommended that if considering tissue repair, the Shouldice technique is the choice as recommended by the EHS and APHS guidelines (1,18).

Mesh prosthetic repair

Even with excellent tissue repair techniques, recurrences are still a big problem among surgeons. Publications by Read and Rosch made surgeons realize the role of impaired collagen metabolism as the etiology of adult groin hernias and why tissue repairs will fail (19,20). Because of these changes, an inherent weakening of the fibroconnective tissue of the groin will occur and thus the development of inguinal hernias. These findings also stimulated other authors to develop a solution by using prosthetic materials. During the early phase of prosthetic development, surgeons were faced with failures as well as prosthetic material rejection utilizing different types of grafts until more stable materials were discovered (21-29).

Francis Usher introduced polypropylene in 1963. Usher is both a general surgeon and has a degree in pharmacology. He studied a new polyolefin product, which was Marlex [1955] and asked the manufacturer to produce a mesh to his specification. After experimentation this was used for inguinal and incisional hernia repair in humans and was reported in 1958 (30). A better variant of Marlex is Polypropylene, which was initially introduced as a suture in 1962 and eventually became a mesh in 1963. Since then this has been the backbone in the development of prosthetic materials (31).

Among the prosthetic groin hernia repairs, the Lichtenstein technique is the most popular, easily learned and the results easily reproducible by a non-hernia specialist. It is also the most studied among the open mesh techniques and considered the gold standard in open mesh inguinal hernia repair.

Lichtenstein technique

The Lichtenstein technique was conceptualized by the group of Lichtenstein, Amid and Shulman. Their main basis is that due to the metabolic nature of groin hernia, repairs should be done tension free and with the use of a prosthetic material (32). The technique started in 1984 and the data was published in 1989 with an impressive result of

zero recurrence in a five-year follow-up (33). The technique entails placing a mesh to reinforce the inguinal floor after proper dissection of the cord structures and reduction of the hernia sac. The technique eventually evolved due to recurrences seen after the five-year follow up. Changes made were the following:

- (I) Use of a bigger mesh (7.5 cm × 15 cm);
- (II) With the bigger mesh, overlaps must be observed: 2 cm at the pubic tubercle, 3–4 cm at the medial side and 5–6 cm lateral to the internal ring;
- (III) Interrupted suturing is done at the medial side to prevent entrapping the iliohypogastric nerve;
- (IV) Dome shaped configuration of the mesh after implantation to accommodate intra-abdominal pressure and shrinkage of the mesh;
- (V) Identification of the ilioinguinal, iliohypogastric and genital nerve to prevent chronic inguinal pain.

The changes made were due to technical and design flaws identified from the original technique. A smaller and narrow mesh caused recurrences at the pubic tubercle and will not provide enough contact between the mesh and the inguinal floor for proper integration of the mesh. With the mesh kept flat, it is subject to strain when the patient stands up after surgery and will also not accommodate shrinkage of the mesh. Using a continuous suture medially puts the iliohypogastric nerve at risk of entrapment (7,34,35).

The Lichtenstein technique properly taught is easily reproducible and easy to master. This was shown by several studies published by several authors with special interests in hernia that reported a 0.07% recurrence rate and an infection rate less than 0.5% (36-40).

The Lichtenstein technique was not free from modifications. Several surgeons proposed modifications to improve their results and to address issues that the anterior approach cannot address such as a femoral hernia. Modifications introduced involve the technique of fixation using glue or a self-fixating mesh and modifications of the mesh design to include a plug and an underlay. With the use of the glue (fibrin glue and cyanoacrylate), there was no difference in recurrence rate and there was a tendency for less chronic inguinal pain, less hematoma formation and numbness (41-44). With the self-fixating mesh, results showed less chronic inguinal pain but with comparable results to recurrence rates and complications with the Lichtenstein technique (45,46). EHS 2014 guideline concluded that there might be a short-term benefit for post-operative pain with the use of atraumatic fixation for

Lichtenstein hernia repair and atraumatic fixation can be used without increasing the rate of recurrence in 1 year (10).

Only the two modifications in the prosthetic design have been well studied. This is the mesh-plug technique and the bilayer device. The mesh plug patch includes putting a mesh plug through the defect and then a mesh overlay anteriorly. Results of the plug and patch compared to Lichtenstein showed a shorter operative time for the plug and patch and comparable short term and long-term results (47,48). The bilayer device popularized by Gilbert utilizes two prosthetic materials connected together by a connecting piece. The two prosthetic materials are deployed as an underlay and an overlay mesh. The connecting piece functions like a plug through the hernia defect. With the Gilbert's technique, it is necessary to go through the internal ring or the floor to dissect the pre-peritoneal space in order to deploy the underlay mesh. Gilbert reports that this technique is reproducible when done by non-hernia specialists compared with a hernia specialist with a recurrence rate of 0.0012 and 0.0014 respectively (49). In comparison to the Lichtenstein technique, results showed no difference in recurrence and chronic inguinal pain (47,50,51).

Mesh versus non mesh repairs

Open anterior inguinal hernia repairs can be done using tissue repair or mesh repair as shown above. Looking at evidence, there are overwhelming evidence in the use of prosthetic materials in terms of recurrence rates and incidence of chronic inguinal pain. Use of prosthetic material is superior over tissue repair. This has already been proven by hernia database studies, systematic reviews and meta-analysis (52,53). This is the reason why guidelines also states that use of the mesh is mandatory for inguinal hernia repair unless clinical conditions dictate non utilization of the mesh (1,10,18).

Groin hernia in females

There are differences in the female groin anatomy that has to be considered in groin hernia repair. The configuration of the female pelvis and differences in the musculoaponeurotic attachments requires adjustment in the technique of repair. Due to these differences, females have a higher chance of developing femoral hernias (54). In the management of female groin hernias, mesh repair is recommended. During surgery, the existence of a femoral

hernia should be excluded. This can be done by utilizing a pre-peritoneal approach (18).

Recurrent hernias

Despite excellence in the technique and advances in prosthetic materials, groin hernia surgery is not free of recurrences. Management of recurrences may incur difficulties depending on the previous operative technique. Proper planning is indicated and knowledge of the previous repair must be known. Campanelli *et al.* published a classification of recurrent hernias and their management (55). The classification is as follows:

- ❖ R1—recurrence near the internal inguinal ring with a defect of <2 cm to be managed by Gilbert's plug repair;
- ❖ R2—recurrence above the pubic tubercle to be managed by Wantz pre-peritoneal repair;
- ❖ R3—recurrence with whole inguinal defect to be managed by Stoppa approach.

EHS guidelines recommends that if the previous surgery is an anterior mesh repair then the approach should be posterior either open or endoscopic and if the previous approach is posterior then the management will be an anterior approach. This is to facilitate easier surgery due to the virgin planes of dissection (18). However, if both planes have been dissected (previous bilayer device or recurrence of a recurrent hernia), then a tailored approach is warranted.

Summary

In summary, the open anterior approach for groin hernia has been well studied. Knowledge of the key anatomic structures is needed to facilitate proper dissection and surgery. Guidelines will state that Lichtenstein hernia repair is the gold standard for open anterior mesh repair. If the use of prosthetic materials is contraindicated then the Shouldice technique should be used. In female groin hernia, the possibility of a femoral hernia has to be considered and a posterior approach may be warranted. Recurrent hernia management requires careful planning and knowledge of the previous surgery such that a tailored approach may be used.

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