Journal of Society Medicine
Research & Review Articles on Diseases
Journal of Society Medicine. 2026; 5 (2)

Open Surgical Repair of Adult Inguinal and Femoral Hernias: Contemporary Techniques and Clinical Outcomes

Nanda Subhan [1*]

[1] *Department of Surgery, Faculty of Medicine/Syiah Kuala University, Aceh, Indonesia*

***Corresponding Author**: Nanda Subhan, Email: nanda.subhan.id@gmail.com

ARTICLE INFO

Article history:
Received
29 December 2025

Revised
21 January 2026

Accepted
28 February 2026

Manuscript ID:
JSOCMED-291226-52-4

Checked for Plagiarism: Yes

Language Editor:
Rebecca

Editor-Chief:
Prof. Aznan Lelo, PhD

ABSTRACT

Groin hernias, particularly inguinal and femoral hernias, represent one of the most common conditions requiring surgical intervention in general surgery. Although minimally invasive approaches have gained increasing popularity, open surgical repair continues to play an essential role in contemporary practice, especially in patients with anatomical complexity, prior pelvic surgery, or contraindications to laparoscopic procedures. This review provides a comprehensive overview of the principles, anatomical considerations, indications, and operative techniques associated with open repair of adult inguinal and femoral hernias. A detailed understanding of groin anatomy, including the inguinal canal, Hesselbach's triangle, and femoral ring, is fundamental to achieving an accurate diagnosis and ensuring safe surgical repair. Multiple operative techniques have been developed and can broadly be classified into mesh-based tension-free repairs and primary tissue repairs. Among mesh techniques, the Lichtenstein repair remains the most widely adopted approach owing to its technical simplicity, reproducibility, and consistently low recurrence rates. Open preperitoneal mesh repairs also provide effective coverage of the myopectineal orifice and may be particularly advantageous in femoral hernias. Non-mesh techniques, such as the Shouldice, Bassini, and McVay repairs, remain relevant in selected clinical scenarios, particularly when prosthetic material is contraindicated. Overall, open surgical repair remains a safe and effective strategy for the management of groin hernias, offering durable outcomes when performed with meticulous attention to anatomical landmarks and operative techniques. Appropriate patient selection and adherence to evidence-based surgical principles are critical for minimizing complications and reducing recurrence. This review aims to summarize current surgical principles, operative techniques, and clinical outcomes associated with open repair of inguinal and femoral hernias in adult patients.

Keywords

Inguinal Hernia, Femoral Hernia, Open Surgical Repair, Lichtenstein Technique, Mesh Repair, Groin Hernia Surgery.

How to cite: Subhan N. Open Surgical Repair of Adult Inguinal and Femoral Hernias: Contemporary Techniques and Clinical Outcomes. *Journal Soc. Med*. 2026; 5 (2): 60-68. **DOI: https://doi.org/10.71197/jsocmed.v5i2.265**

INTRODUCTION

Surgical repair represents definitive management for all types of hernias, regardless of their anatomical origin or classification. Groin hernias represent one of the most common surgical conditions worldwide, with more than 20 million hernia repair procedures performed annually. In general surgical practice worldwide, inguinal hernia repair is one of the most frequently performed procedures. Numerous operative techniques have been developed and refined over time to improve surgical outcomes and reduce postoperative complications. When performed by experienced surgeons, both open and minimally invasive approaches have demonstrated favorable outcomes with relatively low recurrence rates. The selection of the most appropriate surgical technique should therefore be individualized, taking into account patient-specific factors, anatomical considerations, and the surgeon's expertise. In addition, clear communication with patients regarding the

potential advantages and limitations of each surgical option is essential to ensure appropriate expectations and informed decision-making [1,2].

This review focuses on the principles and operative strategies involved in the open repair of inguinal and femoral hernias in adult patients. Other important aspects of groin hernia management, including classification, clinical diagnosis, general treatment strategies, and minimally invasive approaches, such as laparoscopic and robotic repairs, have been discussed in the dedicated literature. In modern surgical practice, minimally invasive techniques for groin hernia repair are generally preferred because they are associated with faster postoperative recovery and reduced postoperative pain compared with traditional open procedures [3,4]. Nevertheless, open surgical repair remains an important option in selected clinical situations in which minimally invasive approaches may not be feasible or appropriate. Several patient-related and disease-specific factors may favor the use of an open approach. These include anatomical considerations, the presence of complicated hernias, and circumstances in which prosthetic mesh placement is undesirable or contraindicated, such as contaminated surgical fields resulting from bowel perforation. In addition, patient preference and ability to tolerate general anesthesia should be carefully considered when determining the optimal surgical strategy. Common clinical indications for open groin hernia repair include inability to undergo general anesthesia, history of prior pelvic surgery or pelvic radiation, and complicated hernias such as strangulated or incarcerated inguinal hernias. Other situations that may necessitate an open approach include large scrotal hernias, ascites, and active local or systemic infections, all of which may limit the safety or feasibility of minimally invasive repair.

Anatomy of the Inguinal Canal

The anatomical structure of the inguinal canal is shown in Figure 1.

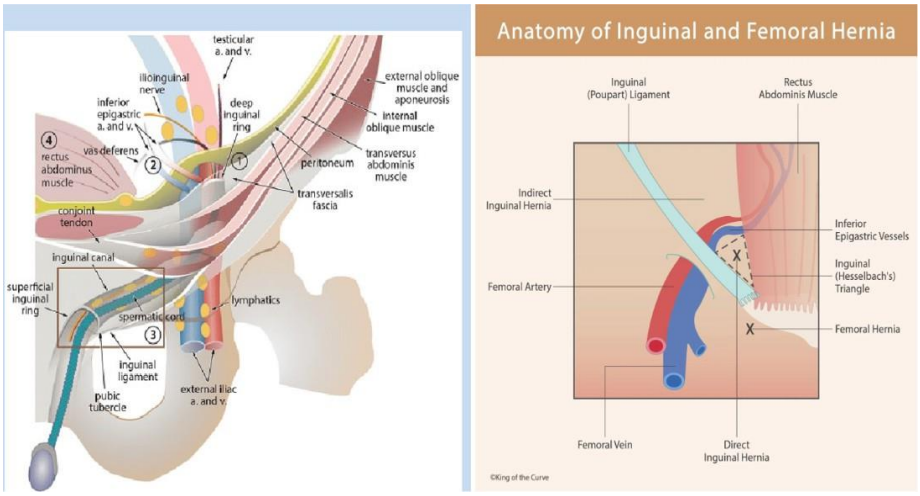

Figure 1. Anatomical structure of the inguinal canal and surrounding abdominal wall layers

The inguinal canal represents an oblique passage through the lower anterior abdominal wall, allowing passage of the spermatic cord in males and the round ligament in females. Structurally, the anterior wall of the canal is primarily formed by the aponeurosis of the external oblique muscle, whereas the posterior wall is mainly composed of the transversalis fascia reinforced by the fibers of the transversus abdominis muscle. The superficial (external) inguinal ring is an opening within the aponeurosis of the external oblique muscle that serves as the exit point of the inguinal canal. In contrast, the deep (internal) inguinal ring is located within the transverse fascia and marks the entrance of the canal from the abdominal cavity. Posterior to the inguinal canal lies important vascular structures, including the iliac vessels, which pass along the posterior abdominal wall. A comprehensive understanding of the inguinal canal and surrounding abdominal wall anatomy is essential for safe surgical dissection and accurate identification of hernia defects during operative repair. A more detailed discussion of the abdominal wall anatomy is available in dedicated anatomical references.

Hernia Locations

Indirect inguinal hernias arise at the level of the deep (internal) inguinal ring, which represents the point where the spermatic cord enters the inguinal canal in males and the round ligament in females. These hernias originate laterally to the inferior epigastric vessels and typically follow the course of the inguinal canal toward the superficial inguinal ring. In contrast, direct inguinal hernias occur due to weakness of the posterior wall of the inguinal canal and protrude through the Hesselbach triangle, a region located medial to the inferior epigastric vessels (Figure 2).

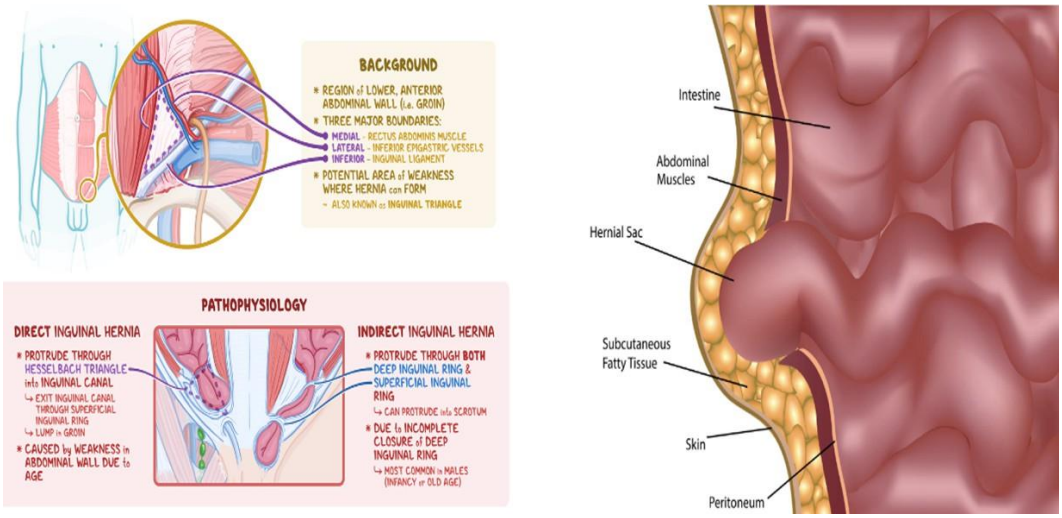

Figure 2. Anatomical Location of Direct Inguinal Hernia within the Hesselbach Triangle

The Hesselbach triangle is anatomically defined by three boundaries: the rectus abdominis muscle medially, the inguinal ligament inferiorly, and the inferior epigastric vessels laterally. Herniation through this region usually results from progressive attenuation of the transversalis fascia. Femoral hernias represent another type of groin hernia and occur when the abdominal contents protrude through the femoral ring into the femoral canal (Figure 3).

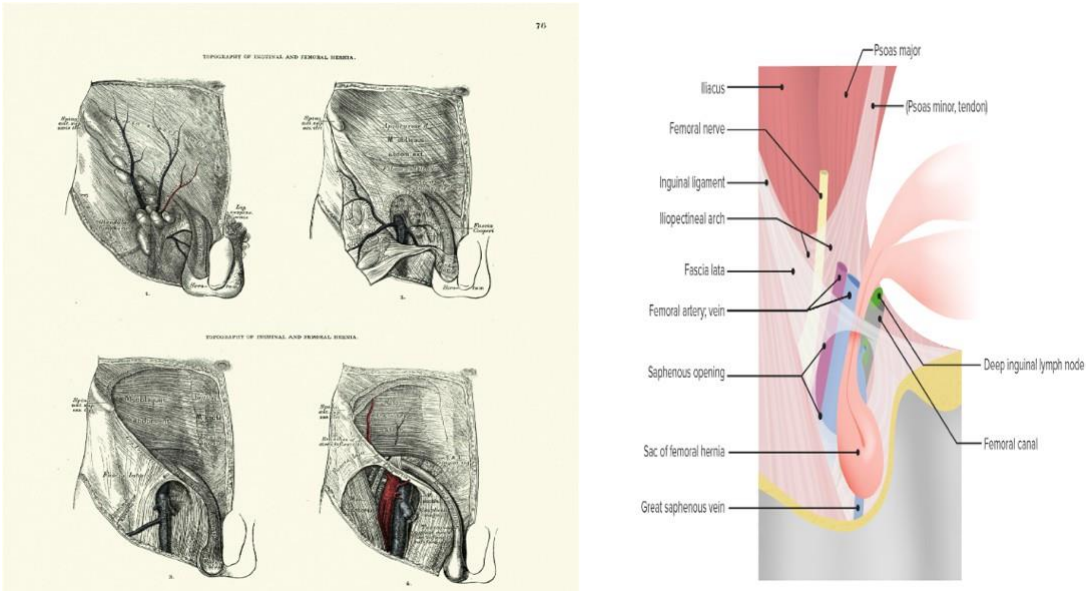

Figure 3. Anatomical Location of Femoral Hernia in the Femoral Canal

The femoral ring is anatomically bordered by the inguinal ligament anteriorly, pectineal fascia posteriorly, lacunar ligament medially, and femoral vein sheath laterally. Owing to the narrow and rigid

boundaries of the femoral canal, femoral hernias have a relatively higher risk of incarceration and strangulation than inguinal hernias.

Pelvic Anatomy

Anatomical differences in the pelvic structure between males and females may influence the pattern of groin hernia occurrence. The configuration of the female pelvis, along with variations in the musculoaponeurotic attachments of the lower abdominal wall, is believed to contribute to the relatively higher incidence of femoral hernias in women. Conversely, direct inguinal hernias tend to occur less frequently in female patients than in male patients [5]. These differences are partly related to the wider pelvic anatomy and structural arrangement of the inguinal region in females, which may alter the distribution of mechanical forces across the groin and predispose to femoral canal herniation rather than defects in the posterior inguinal wall.

Preoperative Evaluation and Preparation

A comprehensive preoperative assessment is essential before the surgical repair of inguinal or femoral hernias. Proper evaluation helps identify patient-specific risk factors, optimize perioperative safety, and guide appropriate surgical planning. Important considerations during the preoperative period include the assessment of thromboembolic risk and the potential need for thromboprophylaxis, administration of prophylactic antibiotics when indicated, strategies to prevent postoperative urinary retention, and initial stabilization of patients presenting with complicated hernias. In addition, careful evaluation of anesthetic options should be performed, considering patient comorbidities, surgical complexity, and the planned operative approach. A detailed discussion of preoperative preparation and perioperative management strategies for groin hernia repair is available in the specialized clinical literature.

Anesthetic Considerations

In contrast to minimally invasive groin hernia repair, which typically requires general anesthesia, open surgical repair of groin hernias can be performed using local, regional, or general anesthesia depending on the clinical situation and patient characteristics. Local anesthesia is generally preferred for elective open inguinal hernia repair. Several studies have demonstrated that procedures performed under local anesthesia have several advantages over other anesthetic techniques, including shorter operative duration, reduced hospital stay [6]. improved patient satisfaction, and lower overall healthcare costs [7]. In addition, the incidence of postoperative urinary retention is markedly lower with local anesthesia. Reported rates are approximately 0.1% with local anesthesia, compared with 8.6% with regional anesthesia and 1.4% with general anesthesia [8].

In elderly patients, particularly those older than 65 years, regional anesthesia is generally discouraged for elective open groin hernia repair. Evidence suggests that regional anesthesia in this population may be associated with a higher incidence of medical complications, including myocardial infarction, pneumonia, and venous thromboembolism, with reported complication rates of 1.17% compared to 0.59% for general anesthesia [9]. Although both local and general anesthesia may be used, many clinicians favor local anesthesia because of concerns regarding the potential cognitive effects of general anesthesia in older patients [10]. In emergency situations, such as incarcerated or strangulated groin hernias, general anesthesia may be necessary. This approach allows adequate muscle relaxation to facilitate the reduction of herniated contents and provides flexibility for conversion to laparotomy if bowel resection or additional intra-abdominal procedures are necessary.

Surgical Techniques

A wide range of open surgical methods have been developed for the management of groin hernias. These techniques are generally classified into two principal categories: tension-free mesh repair and primary tissue repair, as summarized in Table 1 [11-13].

Table 1. Classification of Open Surgical Techniques for Groin Hernia Repair

Category	Technique	Key Characteristics
Tension-Free Mesh Repair	Lichtenstein repair	The most widely used open mesh technique is placement of a prosthetic mesh over the posterior wall of the inguinal canal.
	Plug-and-patch repair	Mesh plug inserted into the hernia defect, followed by placement of an onlay mesh patch
	Prolene Hernia System (PHS)	Bilayer mesh reinforcement of the preperitoneal space and posterior wall
Primary Tissue Repair	Bassini repair	The conjoint tendon was sutured to the inguinal ligament to reconstruct the inguinal floor.
	Shouldice repair	Multilayer reconstruction of the transversalis fascia
	McVay repair	Repair involving Cooper's ligament for inguinal and femoral hernias

Mesh Repairs

When the use of prosthetic material is clinically appropriate and acceptable to the patient, tension-free mesh repair is generally preferred over traditional tissue-based repairs. The rationale for this approach lies in the ability of mesh reinforcement to reduce tension at the repair site, thereby lowering the risk of recurrence, which is often associated with direct tissue approximation. Among mesh-based techniques, procedures that involve the placement of a flat prosthetic mesh in a single anatomical plane are commonly favored. Examples include the Lichtenstein repair and various open preperitoneal repair techniques, both of which have demonstrated reliable outcomes in clinical practice. These methods are typically recommended over alternative mesh approaches, such as the plug-and-patch technique or bilayer mesh systems, which may be associated with higher rates of foreign-body reaction, mesh migration, or postoperative discomfort.

Lichtenstein Repair

The Lichtenstein technique is the most widely used form of open, tension-free mesh repair for inguinal hernias [14]. In this procedure, a flat prosthetic mesh is positioned anteriorly over the inguinal floor in an onlay configuration, reinforcing the posterior wall of the inguinal canal [15,16]. Owing to its relative technical simplicity, reproducibility, and favorable long-term outcomes, Lichtenstein repair has become the most extensively studied technique in open inguinal hernia surgery [17]. This method is considered appropriate for most inguinal hernias. However, it is generally not recommended for femoral hernias, as the mesh placement in this technique does not adequately cover the femoral ring.

Preperitoneal Repair

In contrast to the Lichtenstein approach, open preperitoneal repair techniques involve placement of a prosthetic mesh in a posterior underlay position, similar to the mesh placement used in minimally invasive repairs [18]. This approach allows for broader reinforcement of the myopectineal orifice, thereby enabling effective repair of both inguinal and femoral hernias [19-21]. Several open preperitoneal techniques have been described, including Nyhus, Rives, Stoppa, Read, Wantz, and Kugel repair. These approaches have demonstrated recurrence rates comparable to those reported for the Lichtenstein technique. Nevertheless, the current evidence is insufficient to establish the superiority of any single preperitoneal method over others [4].

Plug-and-Patch Repair

The plug-and-patch technique was initially developed for the treatment of femoral hernias but was later extended to include the repair of direct inguinal hernias. In this method, the hernial sac is first reduced or inverted, after which a conical or rolled mesh plug is inserted into the defect. This was followed by the placement of a flat mesh patch over the inguinal floor to reinforce the repair. Despite its historical use, this technique has become less favored because of concerns that the mesh plug may migrate or cause chronic postoperative pain. Current guidelines on inguinal hernia management discourage the routine use of plug-based or bilayer mesh systems [3].

Bilayer Mesh Repair

Bilayer mesh repair systems combine elements of both anterior and posterior mesh placements. In this technique, one layer of mesh is positioned in the preperitoneal space, whereas a second layer is placed anteriorly over the transversalis fascia, providing dual reinforcement of the inguinal region [22]. Although this approach was developed to enhance the strength of repair, its clinical advantages over simpler mesh techniques remain uncertain, and its routine use has not been universally recommended.

Nonmesh Repairs

Repair techniques that do not use a prosthetic mesh rely on the direct approximation of native tissues to close the hernia defect. Historically, these methods were widely used before the introduction of the modern mesh-based repair. However, tissue-based repairs are generally associated with higher recurrence rates, and failure of hernia repair has frequently been attributed to tension created during direct tissue approximation [23-28]. Although certain operative strategies, such as relaxing incisions, may reduce tissue tension, achieving a truly tension-free repair using most non-mesh techniques remains challenging.

Shouldice Repair

The Shouldice technique is an anterior open approach specifically developed for inguinal hernia repair [29]. In this procedure, the layers forming the floor of the inguinal canal are carefully divided to allow reduction of the hernial sac. The inguinal floor was subsequently reconstructed using a four-layer overlapping suture technique with continuous fine-wire sutures to reinforce the posterior wall and close the defect [30]. This multilayered reconstruction distributes tension across several tissue layers and is thought to minimize excessive stress on any single anatomical structure.

Desarda Repair

The Desarda technique is another tissue-based repair method that avoids the use of prosthetic meshes. In this approach, a strip of the external oblique aponeurosis is mobilized and used as a dynamic flap to reinforce the posterior wall of the inguinal canal, functioning in a manner somewhat analogous to mesh reinforcement in the Lichtenstein technique. Compared with Shouldice repair, the Desarda method is considered technically less demanding and may have a shorter learning curve. Early clinical results have shown encouraging outcomes; however, robust long-term evidence regarding recurrence rates and chronic postoperative pain remains limited [31], and current data are insufficient to support widespread adoption [4].

Bassini Repair

Bassini repair, first introduced in 1887, is one of the earliest formalized techniques for inguinal hernia surgery and has undergone multiple modifications over time [32]. This method strengthens the posterior inguinal wall by suturing the conjoined tendon to the inguinal ligament, extending medially from the pubic tubercle toward the region of the internal inguinal ring laterally. Although historically important, Bassini repair is now less commonly performed because it is associated with relatively higher recurrence rates compared to modern mesh-based repairs [33].

McVay Repair

McVay repair (also known as Cooper’s ligament repair) is the only classical non-mesh technique that can be used to repair both inguinal and femoral hernias [33]. This method is technically more demanding than Bassini repair and involves entering the preperitoneal space by incising the transversalis fascia near the Hesselbach triangle to expose the Cooper’s ligament (pectineal ligament). In this procedure, the conjoined tendon is sutured to the Cooper’s ligament, beginning at the pubic tubercle and extending laterally toward the region where the femoral sheath crosses the ligament. A transition stitch may then be placed to incorporate the conjoined tendon, Cooper’s ligament, medial portion of the femoral sheath, and inguinal ligament. In some cases, the femoral sheath may not be clearly identifiable and can be excluded from the suture line.

The remaining portion of the inguinal floor was reconstructed by approximating the conjoined tendon to the inguinal ligament, extending laterally toward the internal ring. Because this technique produces significant tissue tension, a relaxing incision is typically required. This incision was created by exposing the anterior rectus sheath behind the external oblique aponeurosis and extending the incision cephalad several centimeters from the pubic tubercle. Similar relaxing incisions may also be applied in other tissue-based hernia repair techniques to reduce tension at the repair site.

Clinical Decision Algorithm

The selection of the most appropriate open surgical technique for groin hernia repair depends on several clinical factors, including the type of hernia, patient comorbidities, presence of contamination, and surgeon expertise. A simplified decision-making framework for selecting open repair techniques is shown in Figure 4.

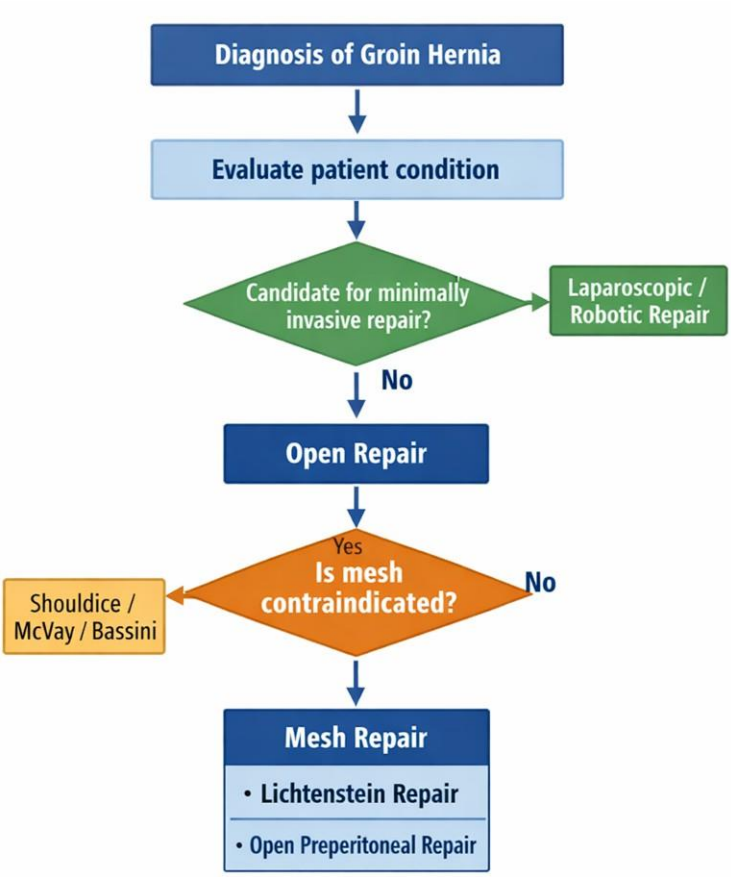

Figure 4. Clinical Decision Algorithm for Open Groin Hernia Repair

CONCLUSION

Open surgical repair remains an important option in the management of adult groin hernias, despite the increasing use of minimally invasive techniques. Successful outcomes depend on a thorough understanding of groin anatomy, appropriate patient selection, and meticulous surgical technique. Among the available procedures, tension-free mesh repair—particularly the Lichtenstein technique—remains the standard approach for most inguinal hernias because of its simplicity and low recurrence rates. Open preperitoneal repair may offer advantages in selected situations, especially for femoral hernias or complex anatomy. Although non-mesh techniques are now less commonly performed, they remain valuable when prosthetic materials are contraindicated. Continued research is needed to optimize surgical strategies and improve long-term outcomes.

DECLARATIONS

The authors declare no conflicts of interest related to this review.

CONSENT FOR PUBLICATION

The authors agree to publish this article in the Journal of Society Medicine.

FUNDING

This study was not supported by any external funding.

COMPETING INTERESTS

The authors declare no conflicts of interest.

AUTHORS' CONTRIBUTIONS

NS contributed to the conceptualization of the study, literature review, drafting, and final revision of the manuscript. The authors approved the final version of the manuscript and are accountable for all aspects of this work.

ACKNOWLEDGMENTS

None

REFERENCE

1. Simons MP, Aufenacker T, Bay-Nielsen M, Bouillot JL, Campanelli G, Conze J, et al. European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. Hernia. 2009;13(4):343-403.
2. Fitzgibbons RJ Jr, Forse RA. Clinical practice. Groin hernias in adults. N Engl J Med. 2015;372(8):756-763.
3. HerniaSurge Group. International guidelines for groin hernia management. Hernia. 2018;22(1):1-165.
4. Köckerling F, Simons MP. Current concepts of inguinal hernia repair. Visceral Medicine. 2018;34(2):145-150.
5. Zendejas B, Ramirez T, Jones T, Kuchena A, Ali SM, Lohse CM, et al. Incidence of inguinal hernia repairs in Olmsted County, Minnesota. Ann Surg. 2013;257(3):520-526.
6. Nordin P, Zetterström H, Gunnarsson U, Nilsson E. Local, regional, or general anesthesia in groin hernia repair: multicenter randomized trial. Lancet. 2003;362:853-858.
7. Amid PK. Lichtenstein tension-free hernioplasty: its inception, evolution, and principles. Hernia. 2004;8(1):1-7.
8. Kehlet H, Bay-Nielsen M. Nationwide quality improvement of groin hernia repair from the Danish Hernia Database. Ann Surg. 2008;248(2):186-193.
9. Neuman, MD, Fleisher, LA. Risks of regional versus general anesthesia in elderly surgical patients. Anesthesiology. 2011;114(3):495-503.
10. Evered L, Silbert B, Knopman DS, Scott DA, DeKosky ST, Rasmussen LS, et al. Recommendations for the nomenclature of cognitive changes associated with anesthesia and surgery. Anesthesiology. 2018;129(5):872-879.
11. Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. Lancet. 2003;362(9395):1561-1571.
12. Rutkow IM. Demographic and socioeconomic aspects of hernia repair in the United States. Surg Clin North Am. 2003;83(5):1045-1051.
13. Read RC. Recent advances in the repair of groin herniation. Curr Probl Surg. 2003;40(1):13-79.
14. Lichtenstein IL, Shulman AG, Amid PK, Montllor MM. Tension-free hernioplasty. Am J Surg. 1989;157(2):188-193.
15. Amid PK. Lichtenstein tension-free hernioplasty: technical details and results. Am Surg. 1993;59(7):433-436.
16. Amid PK, Shulman AG, Lichtenstein IL. Open tension-free repair of inguinal hernias: the Lichtenstein technique. Eur J Surg. 1996;162(6):447-453.

17. Simons MP, Aufenacker T. Surgical techniques in inguinal hernia repair. Ann Surg. 2010;251(3):491-496.
18. Nyhus LM. Individualization of hernia repair: A new era. Surgery. 1993;114(1):1-2.
19. Stoppa RE. Treatment of complicated groin and incisional hernias. World J Surg. 1989;13(5):545-554.
20. Rives J, Stoppa R, Fortesa L, Nicaise H. Large incisional hernias: the importance of flaps of the abdominal wall and the role of prosthetic materials. Surg Clin North Am. 1984;64(2):307-317.
21. Wantz GE. Experience with the preperitoneal approach for groin hernia repair. World J Surg. 1989;13(5):533-538.
22. Gilbert AI. Anatomical and functional classification for the diagnosis and treatment of inguinal hernias. Am J Surg. 1989;157(3):331-333.
23. Glassow F. Shouldice Hospital technique for inguinal hernia repair. Can J Surg. 1986;29(6):442-446.
24. Shouldice EE. Shouldice repair for groin hernias. Surg Clin North Am. 2003;83(5):1163-1187.
25. Bendavid R. The Shouldice repair. Hernia. 2004;8(1):3-5.
26. Wantz GE. Note: All articles should be written in the same style. Surg Clin North Am. 1993;73(3):571-581.
27. Kingsnorth AN. Treating inguinal hernias. BMJ. 2004;328:59-60.
28. EU Hernia Trialist Collaboration. Comparison of mesh and non-mesh methods of open groin hernia repair. Br J Surg. 2002;89(7):854-859.
29. Shouldice EE. Technique for inguinal hernia repair. Surg Gynecol Obstet. 1953;96:321-326.
30. Bendavid R. Shouldice repair. Hernia. 2010;14(1):1-4.
31. Desarda MP. Desarda technique for inguinal hernia repair: a new approach. J Am Coll Surg. 2001;192(5):643-648.
32. Bassini E. Nuovo metodo per la cura radicale dell'ernia inguinale. Atti Congr Assoc Med Ital. 1887;2:179-182.
33. McVay CB, Anson BJ. Inguinal and femoral hernioplasty. Surg Gynecol Obstet. 1948;86:435-450.