The evolution of minimally invasive inguinal hernia repairs

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Abstract: Groin hernia repairs are one of the most common surgeries performed in the world. The first repairs dates back to ancient Egypt in which physicians reduced the hernia and applied heat to the hernia sac. This review article explores the evolution of inguinal hernia repairs. It begins with the history of open inguinal hernia repairs and the evolution of minimally invasive approaches from laparoscopic to robotic repairs. The article also provides a comprehensive review of inguinal hernia anatomy and the myopectineal orifice. Laparoscopic inguinal hernia repairs are the recommended approach by multiple international guidelines to bilateral and recurrent hernias. This article provides a review of the comparison between open Lichtenstein (OL) repairs with minimally invasive approaches such as the laparoscopic transabdominal preperitoneal (TAPP) repair, totally extraperitoneal (TEP) repair and robotic-assisted TAPP repairs. Overall, laparoscopic repairs are associated with reduced post-operative pain, faster return to work/activities, decreased rate of hematoma and wound infections while hernia recurrence are comparable with OL repairs. This article also explores the emergence of robotic-assisted repairs with data suggesting that robotic repairs are a promising approach for patients with complex hernias such as recurrent hernias, post-prostatectomy, and for obese patients. This article also discusses the current utilization of minimally invasive inguinal hernia repairs around the world and the financial implications.

Keywords: Robotic inguinal hernia repair; laparoscopic inguinal hernia repair; minimally invasive inguinal hernia repair; inguinal hernia repair

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Introduction

One of the earliest records of interventions on inguinal hernias dates back to 1550 BC, in which the Eber papyrus describes physicians reducing the hernia and applying heat to the hernia sac. The first surgical inguinal hernia repair was reported by Demetrius Cantemir in 1716, via an open transabdominal approach (1). Although laparoscopic surgery was first introduced by George Kelling in 1901, surgical repair of inguinal hernias remained in an open fashion for the majority of the 1900s. Ger and colleagues described the first laparoscopic inguinal hernia repair conducted in dogs in 1982, in which the abdominal opening of the patent vaginalis processus was closed by a novel stapling device (2). Bogojavalensky later developed the laparoscopic plug and patch repair, inserting a synthetic mesh plug into the hernia defect opening over the peritoneum (3). This technique fell out of favor due to increased risk of small bowel obstructions secondary to adhesions as well as high recurrence rates (4). In 1991, Fitzgibbons *et al.* described the intraperitoneal onlap mesh (IPOM) repair in pigs using a polypropylene mesh, in which an adhesion barrier was affixed over the peritoneum covering the hernia defect (5). Later that year, Toy and Smoot described a similar laparoscopic IPOM technique in ten patients with high ligation of hernia sac, resulting in a tension-free repair and mesh placement over the peritoneum without groin dissection (6). The IPOM technique was also later abandoned due to the risk of mesh erosion into the bowel. Schultz *et al.* were was the first to describe a laparoscopic approach in which the peritoneum was dissected to identify the defect and polypropylene mesh was used to obliterate the defect (7).

Anatomy

Proper understanding of abdominal wall and inguinofemoral anatomy is paramount to surgical repair of inguinal hernias. Bordered by the muscles of the abdominal wall, the inguinal canal is the space through which the gonadal structures (spermatic cord and vas deferens in males, round ligament in females) exit the peritoneal cavity. The anterior wall of the inguinal canal is formed by the aponeurosis of the external oblique, while the posterior wall is formed by the transversalis fascia. The roof of the inguinal canal comprises the transversalis fascia, internal oblique, and transversus abdominis muscles; and the floor is formed by the inguinal ligament. The deep opening into the canal is the internal (deep) ring and the superficial opening out of the canal (into the scrotum in males) is the external (superficial) ring.

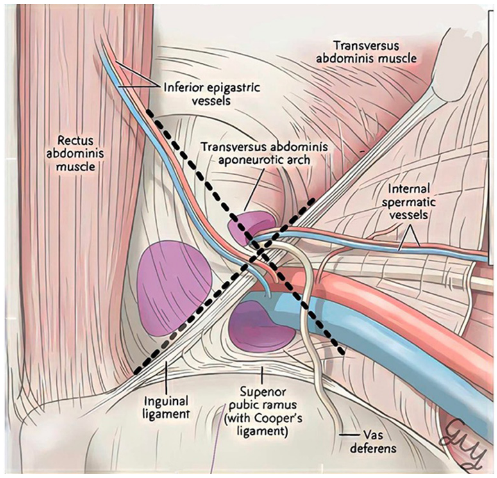

Figure 1 Myopectineal orifice. Direct hernias pass through the abdominal wall medial to the inferior epigastric vessels. Indirect hernias pass lateral to the inferior epigastric vessels, within the inguinal canal before exiting in the external ring. Femoral hernias occur below the inguinal ligament and are caused by herniation of the peritoneal contents through the empty space medial to the femoral vein within the femoral triangle. In laparoscopic hernia repairs, mesh is placed covering the myopectineal orifice (from Tansawet *et al.*, 2022 in *Frontiers in Surgery*, reproduced with permission under Creative Commons Attribution Noncommercial License).

Inguinal hernias are defined by their relationship to the inguinal canal, as well as within Hasselbach's triangle (*Figure 1*) (8). Bordered by the rectus sheath medially, the inferior epigastric vessels laterally, and the inguinal ligament inferiorly, Hasselbach's triangle distinguishes direct from indirect inguinal hernias. Direct inguinal hernias are caused by weakness in the transversalis fascia, which forms the posterior wall of the inguinal canal. As true hernias, direct hernias pass through the abdominal wall medial to the inferior epigastric vessels, into the inguinal canal and out through the external inguinal ring. In contrast, indirect hernias are caused by a patent processus vaginalis, an embryonic remnant of the peritoneal tunnel leading to the inguinal canal. In male fetal development, the testes migrate through the process vaginalis, led by the gubernaculum, into the scrotum. Persistence of the processus vaginalis allows abdominal contents to pass through the internal ring, through the inguinal canal, and out through the external ring. Thus, direct hernias travel deep to superficial, passing medially to the internal ring, while indirect hernias travel

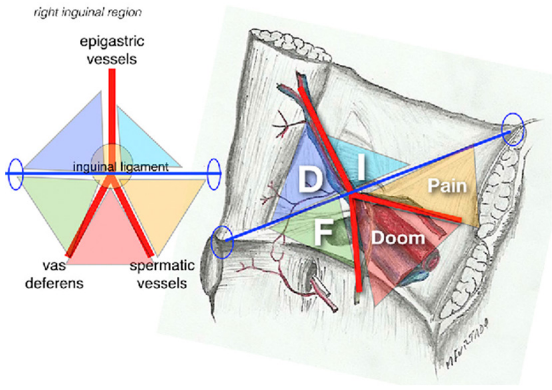

Figure 2 The classic "five triangles" view of laparoscopic hernia repair. Counterclockwise from Hasselbach's triangle [1], which defines the space through which direct hernias (D) occur, are: [2] the triangular space containing the internal inguinal ring [through which indirect hernias (I) occur], [3] the "triangle of pain" (in which the lateral cutaneous nerve, the femoral branch of the genitofemoral nerve, and the femoral nerve pass), [4] the "triangle of doom" (which contains the external iliac artery and vein), and [5] the triangular space through which femoral hernias (F) occur (from Furtado *et al*., 2019 in Arquivos Brasileiros de Cirurgia Digestiva, reproduced with permission under Creative Commons Attribution Noncommercial License).

lateral to medial within the inguinal canal before exiting in the external ring. Though femoral hernias are not true inguinal hernias, they are often described and managed along the same vein. Femoral hernias occur below the inguinal ligament and are caused by herniation of the peritoneal contents through the empty space medial to the femoral vein within the femoral triangle, which is defined by the inguinal ligament superiorly, the adductor longus medially, and the sartorius muscle laterally (*Figure 1*). The European Hernia Society classifies groin hernias based on three criteria: the size of the hernia orifice, anatomic location and whether it is a primary or recurrent hernia (9). Classic open approaches to inguinofemoral hernia repairs focus on identifying and repairing defects in these individual spaces, usually with reinforcing mesh to prevent recurrence.

While open repairs target inguinal ring and femoral space defects individually, laparoscopic repairs allow for a single operative fix of direct inguinal hernias, indirect inguinal hernias, and femoral hernias through reinforcement of the myopectineal orifice (*Figure 1*). First described by Fruchaud in 1956, the myopectineal orifice encompasses the space through which both inguinal and femoral hernias can occur (8,10). Placement of a large piece of mesh encompassing the entirety of the myopectineal orifice allows repair of all three hernia types and forms the foundation of laparoscopic, and later, robotic, inguinal hernia repair.

Additional anatomic considerations must be considered when repairing inguinal hernias via a minimally invasive approach. Laparoscopic visualization of groin anatomy allows clear identification of type of hernia defect (*Figure 2*) (11). In the classic "five triangles" view, the rectus sheath is oriented medially with the iliopubic tract traveling from the pubic symphysis at midline out laterally and superiorly towards the anterior superior iliac spine (ASIS). The inferior epigastric vessels travel perpendicularly to the pubic tract, separating at the pubic tract into the vas deferens (which travels inferiorly) and the spermatic vessels (which travel laterally). Counterclockwise from Hasselbach's triangle [1], which defines the space through which direct hernias occur, are: [2] the triangular space containing the internal inguinal ring (through which indirect hernias occur), [3] the "triangle of pain" (in which the lateral cutaneous nerve, the femoral branch of the genitofemoral nerve, and the femoral nerve pass), [4] the "triangle of doom" (which contains the external iliac artery and vein), and [5] the triangular space through which femoral hernias occur. When placing mesh in an endoscopic hernia repair, care must be taken to avoid fixation of mesh in the triangles of doom and pain to prevent vascular or nerve injury, while covering all potential spaces in the myopectineal orifice.

Finally, dissection of the potential space in the preperitoneal plane allows proper mesh placement outside the peritoneal cavity, a cornerstone of modern laparoscopic techniques such as transabdominal preperitoneal (TAPP) repair and totally extraperitoneal (TEP) repair. While the two repairs use different approaches, both utilize the same potential preperitoneal space above the peritoneum and below the transversalis fascia, known as the Space of Bogros. In TAPP, surgeons enter the peritoneal cavity and access the preperitoneal plane through a transverse peritoneal incision, later closing the peritoneal flap with sutures or tacks. In contrast, TEP accesses the preperitoneal space through an infraumbilical incision, avoiding entering the peritoneal cavity entirely.

Evolution of TAPP and TEP repairs

Laparo-endoscopic meshed-based repairs are recommended for unilateral and bilateral groin hernias due to lower incidence of postoperative and chronic pain based on multiple international guidelines (12,13). The two most common laparoscopic inguinal hernia repairs used today began in 1992 when Arregui *et al.* described a laparoscopic preperitoneal approach that employed the same principles of open repairs by replacing and reinforcing the attenuated transversalis fascia. This became known as the TAPP repair. After entering the preperitoneal space by excising the hernia sac, the defect is closed with sutures. Then mesh is placed over the internal ring, testicular vessels, and spermatic cord laterally, Hesselbach's triangle medially and Cooper's ligament inferiorly. The mesh is then secured to transversalis fascia superiorly, iliolumbar tract inferiorly and transversus abdominis lateral to internal inguinal ring. The peritoneum is then reapproximated. Arregui *et al.* found that laparoscopic repairs reduced postoperative pain and recovery time (14). In 1991, Dulucq described the first series of TEP laparoscopic repairs in which the preperitoneal space is dissected using a laparoscope or balloon dissector. This method eliminates both early and late complications related to violation of the peritoneal cavity (15). Sharma *et al.* conducted the first prospective randomized trial comparing laparoscopic TAPP and TEP approaches for bilateral inguinal hernias with 60 patients included in the study and results analyzed on postoperative days 8 and 30. They found both techniques to be equivalent in terms of postoperative mortality, morbidity, wound infection and early recurrence. However, TEP repairs were found to have increased operating time and more subcutaneous emphysema (16). A meta-analysis of 15 randomized clinical trials that included 1,359 patients subsequently found no significant differences between TEP and TAPP repairs in terms of early postoperative pain, operative time, wound-related complications, hospital length of stay, return to work/daily activities, and costs (17). Similar results were seen in a meta-analysis conducted by Feng *et al.* in which ten randomized controlled trials with a total of 1,047 patients were analyzed (18). Current international guidelines do not make specific recommendations between laparoscopic TAPP *vs.* TEP repairs and instead emphasize that the choice should be based on surgeon expertise and preference (12,13). Ielpo *et al.* found in a prospective randomized controlled trial comparing open Lichtenstein (OL) *vs.* TAPP that TAPP repairs were associated with less short term and chronic pain, postoperative complications and shorter length of stay (19). Aiolfi *et al.* conducted a meta-analysis of 35 randomized controlled trials in 2021 comparing Lichtenstein repair with laparoscopic TAPP and TEP repairs. They found that laparoscopic TAPP and TEP repairs were associated with significantly reduced early postoperative pain, return to work/activities, chronic pain, hematoma and wound infection while hernia recurrence, seroma and hospital length of stay similar across all three treatments (20). Additionally, laparoscopic repairs allow surgeons to detect and repair bilateral hernias concurrently (21). Finally, laparoscopic approaches also offer the advantage of closing three potential spaces through which intraabdominal contents can herniate through. prophylactically treating indirect hernias, direct hernias, and femoral hernias with one repair (*Table 1*) (10,17,19-32).

Currently, laparoscopic mesh-based hernia repairs are recommended by multiple international guidelines for repair of inguinal hernias, although each guideline has slight variances. In general, all guidelines recommend laparoscopic approach for bilateral hernias. The Royal College of Surgeons (RCS) recommends a laparoscopic approach in bilateral hernias and in women due to the risk of undiagnosed femoral hernias (33). The European Hernia Society recommends a laparoscopic approach in patients who are employed due to reduced time off work (9). The international HerniaSurge guidelines recommend a laparoscopic approach generally for all men with unilateral hernias (12) However, the rate of laparoscopic inguinal hernia repairs around the world is variable. In an analysis of the incidence and subsequent repair of inguinal hernias in US Armed Forces members from 2010–2019, 45.5% were performed laparoscopically *vs.* 54.5% in an open fashion. The overall proportion of laparoscopic repairs increased from 11.5% in 2010 to 28.4% in 2019 while open repairs peaked in 2013 (32.5%) and decreased to 21.6% in 2019 (34). In a study conducted in England, Palser *et al.* found that 65.5% of bilateral hernias, 17.1% of unilateral hernias, and 31.3% of recurrent hernias were performed laparoscopically in men. The authors hypothesized that the variation in rates of laparoscopic approaches is due to the shorter learning curve of open repairs, as well as reduced index operation costs (35). In Spain, the rate of laparoscopic repairs is much lower for bilateral inguinal hernia repairs, with rates of 12% to 29%. The biggest factor contributing to the type of repair performed was the region that the patient was operated in and whether the hospital/surgeon utilized laparoscopy (36).

Evolution of robotic inguinal hernia repairs

Robotic inguinal hernia repairs represent a natural progression of minimally invasive inguinal hernia surgery.

Table 1 Literature review of efficacy of laparoscopic inguinal hernia repair

Author	Year	Type of study	Results
Ali *et al.*	2023	RCT	Mesh non-fixation in TAPP repairs had similar recurrence and postoperative complications compared to fixation with shorter operative time and lower postoperative pain
Hidalgo *et al.*	2023	Retrospective cohort	TAPP and TEP had similar outcomes in bilateral inguinal hernia repair
Sartori *et al.*	2023	Meta-analysis	Laparoscopic approach seems to be safe approach for acute incarcerated groin hernias
Sekhon Inderjit Singh *et al.*	2022	Meta-analysis—22 RCTs	Chronic groin pain rates lower in laparoscopic repairs compared to open repairs at >5 years (4.69% *vs.* 6.91%). Lower risk of chronic groin pain in TEP repair, not seen in TAPP
Aiolfi *et al.*	2021	Meta-Analysis—35 RCTs	Laparoscopic TAPP and TEP repair associated with significantly reduced early postoperative pain, return to work/activities, chronic pain, hematoma, and wound infection compared to the Lichtenstein tension-free repair. Hernia recurrence, seroma, and hospital length of stay seem similar across treatments
Aiolfi *et al.*	2021	Meta-analysis—15 RCTs	TAPP *vs.* TEP similar in recurrence and chronic pain
Kler *et al.*	2021	Meta-analysis—2 RCTs and 26 observational studies	No observed difference between TAPP and TEP repairs in terms of return to activity, complications, and postoperative pain in 3-month period
Hung *et al.*	2020	Meta-analysis—14 RCTs	TAPP had lower seroma rate and TEP has lower scrotal/cord edema
Lydeking *et al.*	2020	Multi-center single blinded RCTs	TAPP and open Lichtenstein repairs had similar recurrence rate after at 12 years. TAPP repair had lower rates of chronic pain, although not statistically significant (4% *vs.* 7%)
Aiolfi *et al.*	2019	Meta-analysis—16 RCTs	No difference found in comparing open, TAPP, TEP, rTAPP in terms of short-term seroma, postoperative chronic pain, recurrence, urinary retention, SSI and LOS
Bullen *et al.*	2019	Meta-analysis—12 RCTs	Laparoscopic repair associated with reduced rate of acute and chronic pain with similar recurrence rate between open *vs.* laparoscopic
Ielpo *et al.*	2018	Clinical and cost-effectiveness analysis within RCTs	TAPP repair had less early postoperative pain, shorter LOS and fewer postoperative complications when compared to open Lichtenstein repair. TAPP more cost effective than open repairs
Ielpo *et al.*	2018	Prospective RCT	TAPP compared to OL had less postoperative pain, shorter LOS, less postoperative complication, and less chronic pain
Yang *et al.*	2018	RCT	TAPP repairs had lower long-tern postoperative complications, faster recovery and lower rates of chronic pain compared to OL in recurrent hernia
Scheuermann *et al.*	2017	Meta-analysis—8 RCTs	Reduced rate of chronic inguinal pain in TAPP compared to OL
Kargar *et al.*	2015	Prospective RCT	TAPP compared to OL had lower incidence of hematoma, seroma, and infection

Method: search term on PubMed includes "laparoscopic inguinal hernia repair". Only RCT, meta-analysis and systemic review articles were reviewed from 2015–2023. RCT, randomized controlled trial; TAPP, transabdominal preperitoneal; TEP, totally extraperitoneal; rTAPP, robotic transabdominal preperitoneal; SSI, surgical site infection; LOS, length of stay; OL, open Lichtenstein.

The first robotic transabdominal inguinal hernia repairs were performed during concurrent radical prostatectomies (37). However, this approach was quickly adapted by general surgeons due to the advantages of robotic surgery including 10× magnification, three-dimensional views, enhanced endo-wrist dexterity and shorter learning curve (38). The first robotic series of inguinal hernia repairs was published in 2015 in which Engan *et al.* described a single site TAPP repair (39). Like laparoscopy, both robotic extended TEP (eTEP) and TAPP are technically feasible; however, robotic TAPPs are performed with higher frequency given relative ease of intracorporeal suturing with the robotic console. Robotic inguinal hernia repairs have been found to be comparable to laparoscopic repairs. A recent meta-analysis by Solaini *et al.* found that robotic repairs have similar perioperative complications and safety profiles compared to laparoscopic repairs; however, the robotic approach was found to take more time in unilateral repairs (40). Similar results were found in the RIVAL trial, which is the first prospective randomized controlled trial that compared laparoscopic and robotic TAPP repairs (41). However multiple studies have shown that after the initial learning curve, operative times significantly decrease (42,43). Tatarian *et al.* found that robotic TAPP had significantly lower risk of complications and shorter length of stay compared to laparoscopic TAPP and open repairs in a propensity score analysis of 153,727 patients that underwent inguinal hernia repairs in New York State (44). Over the past several years, robotic repairs have risen dramatically with over one-third of inguinal hernia repairs performed on the platform due to the short learning curve compared to laparoscopic repairs, more defined visualization, and improved ergonomics. Proietti *et al.* found in a cumulative summation test that it takes 43 robotic TAPPs to achieve 90% proficiency and significant reduction in operative time from 71 to 60 minutes (45). While it takes about 100 to 240 operations to develop proficiency for laparoscopic repairs (46-48). Moreover, more complex cases including recurrent hernias are performed robotically due to its stability and increased dexterity. Kudsi *et al.* found that although a higher number of complex inguinal hernia defined in the study as (I) cases of recurrence after previous laparoscopic repair; (II) cases of previous prostatectomy; (III) cases of inguinal hernias that did not retract after induction of anesthesia and (IV) cases of scrotal inguinal hernias were performed robotically, the mean operative time, intraoperative and postoperative complications were similar to laparoscopic repairs (49). Kolachalam *et al.* found that in a propensity matched population of obese patients, robotic repairs had lower rates of postoperative complications (3.2% *vs.* 10.8%) and shorter length of stay (1.9 *vs.* 4.4 days) compared to open repairs. The study also found that of the seven surgeons enrolled in the trial, three had no previous experience in laparoscopic hernia repairs prior to adoption of the robotic-assisted approach (50). Therefore, robotic-assisted repairs may be a promising approach for patients with complex hernias such as those with recurrent hernias or post-prostatectomy as well as obese patients. Robotic inguinal hernia repairs have been shown to be as safe and effective as laparoscopic repairs and with further implementation of robotic programs across the country, an invaluable tool for complex cases (*Table 2*) (21,38,40-43,51-57).

Financial implications of minimally invasive inguinal hernia repairs

The cost of minimally invasive inguinal hernia repairs is often cited as a limitation to the its implementation, especially in robotic repairs. For unilateral hernias, operating room (OR) and total hospital costs for laparoscopic repairs are found to be on average significantly higher than open repairs ($3,207 *vs.* $3,723). However, costs were found to be similar in elective bilateral repairs (58). Ielpo *et al.* also found that index cost of laparoscopic TAPP repairs is higher compared to OL repairs, but, the mean quality adjusted life years 1 year postoperatively were higher for TAPPs compared to OL, translating to higher cost-effectiveness after TAPPs (29). Perez *et al.* found that patients undergoing laparoscopic repairs had a decreased length of stay, which resulted in more than $2,000 in healthcare savings compared to open repairs (59). Lam *et al.* found that laparoscopic repairs were more cost-effective than open repairs in cases that required overnight stays; however, same day open repairs were even more effective at 18.43% savings (60). Robotic-assisted repairs have a higher median cost compared to laparoscopic repairs ($3,258 *vs.* $1,421) (41). However, Awad *et al.* found that increasing surgeon experience, defined as after 20 cases, was associated with lower mean direct operative cost by $538.17 as well as shorter operative times (51). Therefore, it can be extrapolated that with further implementation of robotic programs across the country, the mean cost and operative times will continue to decrease. Other strategies can be employed to reduce the cost of robotic repairs. One study found that reducing robotic instruments cost by 30% or increasing the use of individual instruments to 15 times (compared to the current use of 10 times) would allow robotic repairs to match the current reimbursement rates (61). Both are possibilities in the future given advances in technology, increasing marketplace competition among robotic platforms and introduction of robotic platforms such as the Cambridge Medical Robotics whose mission is to offer a more affordable alternative to the current Da Vinci system (62).

Table 2 Literature review of efficacy of robotic inguinal hernia repair

Author	Year	Type of study	Results
Ayuso *et al.*	2023	Prospective case study	No difference in recurrence rate, wound infection and readmissions between laparoscopic and robotic inguinal hernia repairs. Operative times were longer for robotic repairs, however 50-minute decrease between beginning and end of study
Miller *et al.*	2023	RCT	Laparoscopic and robotic inguinal hernia repairs have similar long-term outcomes (hernia recurrence, neuropathic pain, health-related quality of life and physical activity)
Ephraim *et al.*	2022	Retrospective study	Significant decrease in operative times in robotic repairs after initial learning curve
Gundogdu *et al.*	2020	Retrospective	Robotic repairs had lower complication rate and less postoperative pain compared with laparoscopic repairs but with longer operative times
Hsu *et al.*	2023	Retrospective study	Robotic, laparoscopic, and open repairs had no difference in postoperative complications. Resident involvement associated with shorter operative times
Solaini *et al.*	2022	Meta-analysis	Robotic group with longer operative time in unilateral repair. Laparoscopic and robotic repair with similar operative times in bilateral repairs. Similar safety profiles. Robotic repairs had higher costs
Bou-Ayash *et al.*	2021	Case series	Robotic approach is feasible option for incarcerated inguinal hernias with shorter LOS and low complication rates
Kakiashvili *et al.*	2021	Retrospective study	Robotic and laparoscopic groups had similar operatives. Robotic repairs were associated with decreased postoperative pain compared to open and laparoscopic repairs
Qabbani *et al.*	2021	Meta-analysis	No difference in postoperative pain, hernia recurrence or readmission rate between open, laparoscopic and robotic repair. Robotic repair had longer operative time and less complications compared to laparoscopic
Zhao *et al.*	2021	Meta-analysis	Laparoscopic and robotic repairs have similar safety profiles and clinical efficacy in Caucasian patients
Awad *et al.*	2020	Retrospective study	After initial 20 cases, mean operative time, operative cost and postoperative complications were decreased
Prabhu *et al.*	2020	RCT	No difference in post operative complications such as wound events, readmissions, and pain between laparoscopic vs. robotic repairs. Robotic repairs associated with longer operative time and higher median cost
Aiolfi *et al.*	2019	Meta-analysis	No difference in postoperative hematoma, SSI, urinary retention and hospital LOS between OL, laparoscopic TAPP, TEP and robotic TAPP

Method: search terms on PubMed include “robotic inguinal hernia repair”, and articles were reviewed from 2015 to 2023. RCT, randomized controlled trial; LOS, length of stay; SSI, surgical site infection; OL, open Lichtenstein; TAPP, transabdominal preperitoneal; TEP, totally extraperitoneal.

Conclusions

Although minimally invasive inguinal hernia repairs have been found to be superior to open repairs in terms of postoperative complications and length of stay, its adoption has not been as universe as other laparoscopic approaches such as cholecystectomies. Most surgeons in the United States continues to prefer open approaches, even for bilateral and recurrent inguinal hernias. The reasons for this preference may be due to the longer learning curve associated with laparoscopic TAPP and TEP repairs as well as the increased economic costs. Robotic-assisted repairs may provide the solution to increasing the rate of minimally invasive inguinal hernia repairs given its shorter learning curve, improved visualization, and enhanced ergonomics especially in the repair of complex and recurrent inguinal hernias.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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