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Sutureless Inguinal Hernia Repair Techniques: A Comparison Between Laparoscopic and Open Methods

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Abstract

Background: The study is designed to compare laparoscopic and anterior sutureless techniques for repairing inguinal hernia.
Methods: For several years, our group has performed both laparoscopic and anterior sutureless inguinal hernia repairs. This retrospective cohort study analyzed 160 patients with inguinal hernias who underwent sutureless surgical alloplasty between July 2018 and July 2019. Eighty patients were treated laparoscopically (transabdominal preperitoneal approach) with a polypropylene mesh secured with fibrin glue (Tisseel®; Baxter Health, Deerfield, IL). The remaining 80 patients underwent open alloplasty using a preformed double-layered polypropylene mesh (Folded-Mesh; Angiologica, Italy) that did not require suture or glue fixation. Clinical follow-up data were collected for a period of 60 months.
Results: The two groups were comparable in terms of age, gender, and ASA score. There was no statistically significant difference in operative time between the laparoscopic and open techniques (34.16 ± 8.50 versus 40.17 ± 7.92 minutes; $P > .05$). No laparoscopic procedure required conversion to open surgery. No perioperative complications were reported in either group. A significant difference was observed in postoperative neuralgia, with 0 cases in the laparoscopic group versus 8 cases in the open group ($P < .05$). Persistent pain (lasting more than 6 months) was reported in only 2 patients in the open group ($P > .05$). Relapse was only observed in the open repair group.
Conclusions: Sutureless inguinal hernia repair is a safe and effective procedure with minimal complications. The laparoscopic approach appears to be superior, offering a faster recovery and fewer postoperative issues, making it the preferred choice for sutureless hernia repair.

Keywords: hernia repair, fibrin glue, folded mesh, chronic pain

Introduction

Inguinal hernia repair is one of the most common surgical procedures performed worldwide.[1–6] Despite advances in surgical techniques, some patients experience chronic debilitating pain following both laparoscopic and open hernia repair, which is often refractory to medical treatment.[7,8] A potential mechanism underlying this chronic pain is damage to the sensory nerves (ilioinguinal, iliohypogastric, and genitofemoral) passing through the inguinal region.[9,10] Nerve damage can occur intraoperatively due to perineural fibrosis, entrapment by staples, sutures or prosthetic materials, or direct trauma from stretching, contusion, electrical injury, or partial or complete transection of the nerve.[11,12]

To reduce the risk of chronic pain after hernia surgery, our group has been performing sutureless hernioplasty for several years in both open and laparoscopic procedures. During laparoscopic repair, adequate mesh fixation can be achieved in the preperitoneal inguinal area using fibrin glue. This method is equivalent to staple fixation and superior to unfixed grafts. Soft fixation with fibrin glue prevents early graft migration and avoids complications associated with the

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use of staples.[13] Graft fixation with fibrin glue is associated with less postoperative pain than stapling.[14]

Currently, the two most commonly used laparoscopic techniques for inguinal hernia repair involve the insertion of mesh into the preperitoneal space: the transabdominal preperitoneal (TAPP) approach and the totally extraperitoneal (TEP) approach.[15–19] Our group has been performing laparoscopic inguinal hernia repair for over 30 years, with a preference for the TAPP technique because it provides a comprehensive view of the different types of inguinal hernia and facilitates the use of large meshes that cover all the inguinal fossae. Like many other surgeons, we prefer the TAPP approach in certain scenarios: recurrent hernias after previous anterior repairs, bilateral hernias, or when there is a strong suspicion of contralateral hernia. In addition, we prefer the TAPP technique when inguinal hernia repair is combined with another laparoscopic procedure that does not carry the risk of peritoneal contamination (e.g., bowel perforation), as well as in primary unilateral hernias in sportsmen.[20,21] For recurrent hernias, a laparoscopic approach offers the advantage of avoiding scar tissue and distorted anatomy from previous anterior repairs, thereby reducing the risk of injury to the vas deferens and testicular vessels. For bilateral hernias, laparoscopic repair allows both hernias to be treated simultaneously without the need for additional incisions. However, we consider certain conditions to be contraindications to the TAPP approach, including nonreducible or incarcerated inguinal hernias, massive scrotal hernias, and hernias in infants, young children, and pregnant women due to the ongoing development of the abdominal wall.

In the open surgical setting, we have been performing tension-free, sutureless hernioplasty for many years. The principles of sutureless hernioplasty are based on the existence of an anatomically closed space within the inguinal canal, below the external oblique aponeurosis.[22] Research has shown that this space has minimal interindividual variation, allowing for the design of a preshaped mesh that universally fits the subaponeurotic inguinal space.[22,23] For a sutureless repair to be effective, the mesh must have stiffness and controlled memory to ensure proper placement and stability.[24]

In this study, we compare the outcomes of sutureless TAPP and open sutureless hernioplasty after a comprehensive 5-year clinical follow-up. Our analysis focuses on postoperative pain, recurrence rates, and long-term complications to assess the efficacy and safety of these two approaches in the management of inguinal hernias.

Materials and Methods

Patient characteristics

The study received approval from the institutional review board of Policlinico San Marco Hospital. A total of 160 patients with unilateral inguinal hernias who met the eligibility criteria were retrospectively included in this study. These patients underwent sutureless inguinal hernia repair between July 2018 and July 2019. Eighty patients underwent sutureless laparoscopic repair (TAPP), whereas the remaining 80 patients underwent open anterior repair. All patients gave informed consent prior to surgery. Inclusion criteria included a Karnofsky performance status score of 80%–100%, a confirmed clinical diagnosis of inguinal hernia, and eligibility for surgery with curative intent.

Sutureless laparoscopic hernia repair

For the laparoscopic approach, patients were positioned supine with their arms at their sides and in a 10°–20° Trendelenburg position. The surgical monitor was placed at the patient's feet with the surgeons standing on either side. A Veress needle was inserted through a small supraumbilical incision to establish pneumoperitoneum. A midline camera trocar was inserted to assess the inguinal region. Lateral ports were placed along the midclavicular line on both flanks. The preperitoneal space was accessed via a transverse peritoneal incision from lateral to medial. The hernia sac was identified, carefully isolated from the vas deferens and testicular vessels, and completely reduced. Peritoneal flaps were prepared, and a polypropylene mesh was placed in the inguinal region and secured with fibrin glue (Tisseel®; Baxter Health, Deerfield, IL). Tisseel consists of two solutions: one containing fibrinogen and aprotinin, and the other containing thrombin and calcium chloride. These components are mixed through a special catheter (DuploTip) and applied to the surgical site, forming a viscous compound that adheres to tissue and turns white and rubbery within seconds. Adhesion strength increases over time, reaching 70% of maximum efficacy within 10 minutes.[25] In addition to its hemostatic properties, Tisseel has been shown to have adhesive properties,[26] promote wound healing,[27] and stimulate fibroblast proliferation.[28] For each inguinal hernia, 1 mL of undiluted Tisseel was used. The peritoneum was then reconstructed using a continuous suture technique.

Sutureless anterior hernia repair

Using the anterior approach, an inguinal incision was made, and the external oblique aponeurosis was opened. The hernia sac was identified, isolated from the vas deferens and testicular vessels, and completely reduced. A preformed double-layered polypropylene mesh (Folded-Mesh; Angiologica, Italy) was placed around the spermatic cord in the inguinal region (Fig. 1). The double-layered mesh forms a "knot" around the cord, securing it without the need for sutures.

Clinical results

Clinical data were collected using standardized reporting forms. Postoperative complications including hematoma, seroma, persistent pain, and wound infection were documented. Patients were interviewed at 1 hour, 12 hours, 48 hours, and 72 hours after surgery to assess pain levels and analgesic requirements. Pain was measured on a visual analog scale (VAS) ranging from 0 to 10. Length of hospital stay, defined as the number of days spent in hospital after surgery, was recorded. Discharge criteria included the absence of serious infection or bleeding, the ability to walk, and adequate pain control with oral analgesics. Patients returned for a follow-up visit 7 days after surgery, where standardized medical histories and physical examinations were performed. They were asked to rate daily pain levels at the surgical site for the first week and then for the second and fourth weeks after surgery and to document the use of

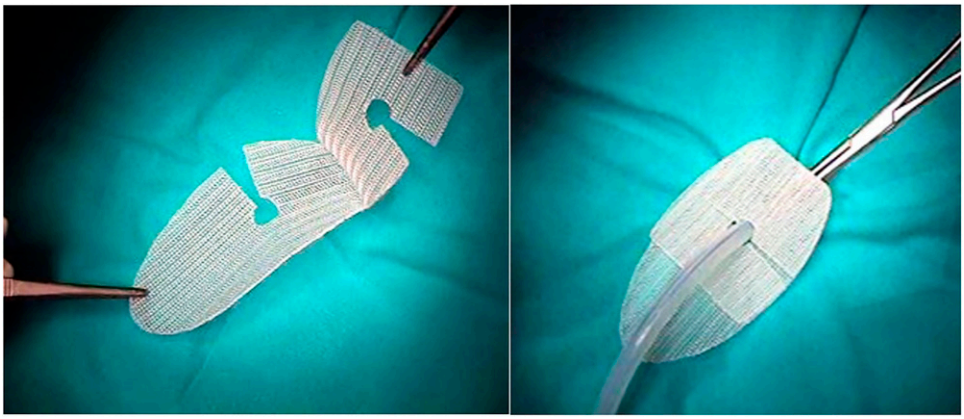

FIG. 1. Preshaped folded mesh made by a double layer of polypropylene (Angiologica, Italy) can easily fix around the spermatic cord.

analgesics. Persistent pain was defined as pain that persisted for at least 6 months after surgery, particularly in the groin, scrotum, or medial thigh. Return to normal activities and work was assessed by questionnaire, with patients recording the date of resumption of routine tasks in a diary. Clinical outcome was assessed over a comprehensive follow-up period of 60 months.

Statistical analysis

Statistical analyses were performed using Student's *t*-test to compare differences between the study groups. A *P* value of <.05 was considered statistically significant. Associations and correlations between variables were assessed using linear models with appropriate adjustments.

Results

Patient characteristics

A total of 160 patients (10 females and 150 males) with unilateral primary or recurrent hernias were included in the study, with a mean age of 55 years (range: 17–83 years). Of these, 80 patients with mainly recurrent inguinal hernias (50 recurrent and 30 primary) underwent laparoscopic repair. The remaining 80 patients, all with primary hernias, were treated using the anterior approach. The 30 patients with primary hernias who underwent laparoscopic repair were either sportsmen or young workers requiring a rapid return to daily activities. All hernias were between 1.5 cm and 3 cm in diameter (Table 1). Recurrent hernias were initially treated with an open technique. No sutures were used to fix the mesh in either group. The two groups of patients were homogeneous in terms of age, sex, and ASA score (Table 1). There was no statistically significant difference in operative time between the two groups: 34.16 minutes (range: 15–60 minutes) for TAPP and 40.17 minutes (range: 25–56 minutes) for anterior hernioplasty (Table 1). No TAPP procedure required conversion to open surgery. No major perioperative complications were reported in either group.

Postoperative morbidity

At 60 months complete follow-up, minor complications such as seroma, skin hematoma, skin anesthesia, orchitis, and wound infection were observed at a low frequency in both groups, with no significant differences between groups (Table 2). These complications did not require surgical intervention or antibiotic treatment. In some cases, anti-inflammatory drugs were administered, and all complications resolved within a reasonable time. A significant difference was observed between the two groups in postoperative neuralgia, with 8 cases reported in the open group and none in the laparoscopic group ($P < .05$). Neuralgia mainly affected the groin-inguinal region, with some cases (3 out of 8) radiating to the ipsilateral flank and thigh. All neuralgias responded to standard analgesics, were sporadic, and resolved within a few months. No persistent pain lasting more than 6 months was reported in the laparoscopic group,

TABLE 1. PATIENTS' CHARACTERISTICS

	Open group 80 patients	*Laparoscopic group 80 patients*
Sex (M/F)	77/3	73/7
Type of hernia according to EHS classification	65 P2L + 15 P2M	25 P2L + 5 P2M 38 R2L + 15 R2M
Mean age (years old)	55 (18–80)	57 (19–83)
ASA score	2 (62 patients), 3 (18 patients)	2 (67 patients), 3 (13 patients)
Mean operative time (minutes)	40 (25–56)	34 (15–60)
Intraoperative complications	None	None (no conversion)

EHS classification: L, lateral/indirect hernia; M, medial/direct hernia; P, primary hernia; R, recurrent hernia; 2 = >1.5 cm, <3 cm (two fingers).

TABLE 2. RESULTS: POSTOPERATIVE MORBIDITIES

	Open group	*Laparoscopic group*
Hospital stay (days)	1.3 (1–3)	1
Recurrences	0	0
Neuralgia	8 (10%)	0
Persistent pain	2 (2.5%)	0
Seroma	2 (2.5%)	2 (2.5%)
Skin/trocar hematoma	2 (2.5%)	1 (1.25%)
Skin anesthesia	2 (2.5%)	0
Orchitis	1 (1.25%)	0
Wound infections	2 (2.5%)	0

whereas two patients in the open group experienced persistent pain (*P* value not statistically significant). Both cases of persistent pain were sporadic, were responsive to analgesics, and were resolved within 7–8 months without further surgical intervention. There were no recurrences in either group during the follow-up period.

Postoperative pain

VAS scores for postoperative pain were significantly lower in the laparoscopic group compared with the open group (Fig. 2). The difference in perceived pain between the two groups was statistically significant between 12 and 72 hours postoperatively ($P < .05$). On days 7, 15, and 30, patients in the laparoscopic group reported no pain, whereas those in the open group reported minimal pain (VAS < 1). The use of analgesics began to decrease in the laparoscopic group as early as 12 hours after surgery (Fig. 3). The difference in analgesic use between the two groups was statistically significant between 24 and 72 hours post-hernioplasty ($P < .05$), with less than half the number of analgesics required in the laparoscopic group compared with the open group. No analgesics were used in the laparoscopic group beyond 7 days after surgery. Hospital stay for the TAPP group was one day, and all 80 patients were discharged the day after surgery (Table 2). In the open surgery group, five patients required a longer stay and were discharged on the third postoperative day due to localized pain. This difference was not statistically significant.

Return to normal activities

Patients in the laparoscopic group returned to normal daily activities significantly sooner than those in the open group

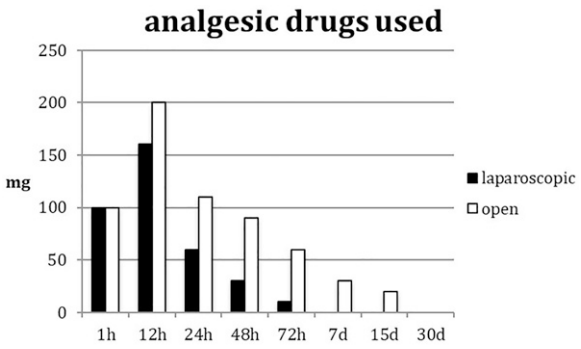

FIG. 3. Use of analgesic drugs in milligram (nonsteroidal anti-inflammatory).

(Fig. 4). At 48 hours postoperatively, 70% of laparoscopic patients were self-sufficient compared with 40% in the open group ($P < .05$). At 72 hours, 80% of laparoscopic patients and 50% of open patients had resumed normal activities ($P < .05$). At 7 days, 98% of laparoscopic patients and 70% of open surgery patients had resumed normal activities ($P < .05$). At 15 days, all patients in the laparoscopic group and 81% of those in the open group had returned to normal daily activities ($P < .05$). After 30 days, all patients in both groups had fully resumed their daily activities.

Discussion

Laparoscopic hernia repair has become one of the most widely performed surgical procedures due to its minimally invasive nature and reduced postoperative pain compared with open surgery.[1–6] In order to minimize postoperative discomfort, our group has been using fibrin glue for mesh fixation instead of traditional tacks for many years. This method has shown effective results in reducing pain and improving patient recovery.

Despite its advantages, laparoscopic hernia repair remains more expensive than conventional open anterior hernia repair and requires general anesthesia. For patients who are not candidates for general anesthesia, we have consistently used sutureless open hernioplasty to achieve comparable results in reducing postoperative and chronic pain. In the open approach, we use a preshaped folded mesh (Fig. 1), which is specifically designed to fit the subaponeurotic inguinal space around the spermatic cord, ensuring secure fixation

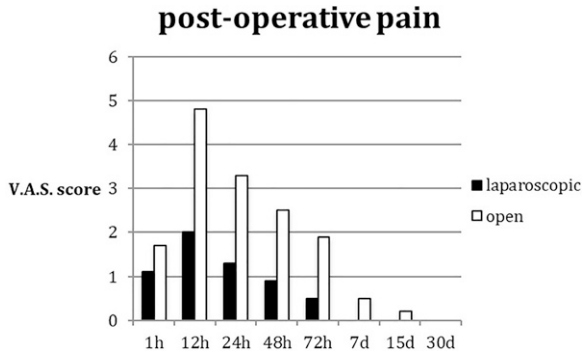

FIG. 2. Postoperative pain, calculated by VAS score. VAS, visual analogue score.

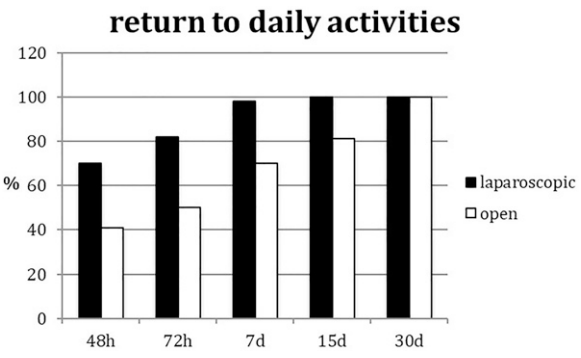

FIG. 4. Return to daily activities. Percentage of patients who return to normal daily activities.

without the need for sutures. This technique further reduces the risk of nerve irritation and complications associated with traditional suturing methods.[29]

Several studies have shown that laparoscopic inguinal hernia repair, particularly using the TAPP technique, results in less postoperative pain, fewer complications, and faster recovery than open techniques, such as the Lichtenstein method.[29–33] These findings are consistent with our experience, where patients undergoing sutureless laparoscopic repair reported less pain and required fewer analgesics, allowing them to return to daily activities more quickly.

Complication rates between laparoscopic and open repair have been studied extensively, with most studies showing no significant differences in the incidence of minor complications such as seroma, hematoma, or wound infection.[34–37] However, the minimally invasive nature of laparoscopic repair plays a significant role in reducing the risk of chronic pain, a well-documented concern following open hernia repair.[32,38] Our study observed that no patients in the sutureless laparoscopic group experienced persistent pain lasting beyond 6 months, compared with two patients in the open group who reported sporadic but manageable pain. Moreover, our study noted a significant difference in postoperative neuralgias, with 8 cases in the open group and 0 cases in the laparoscopic group ($P < .05$). The reduced tissue trauma and nerve preservation associated with laparoscopic techniques contribute to the lower incidence of chronic pain and neuralgia observed in these patients. This effect is further enhanced in our cases where fibrin glue is used instead of traditional fixation methods. Conversely, open repair may carry a higher risk of nerve irritation and prolonged discomfort due to potential nerve entrapment by sutures. However, with our sutureless open approach, the absence of sutures reduces the risk of nerve entrapment and associated complications.

A key advantage of laparoscopic hernia repair is a faster return to normal activities compared with open repair.[32,36,37] This early recovery is closely associated with less postoperative pain and a reduced need for analgesics, further supporting the benefits of minimally invasive techniques.

In terms of operative time, some studies suggest that laparoscopic repairs may be more time-consuming due to the complexity of the procedure and the equipment required.[30,36,39] However, with experienced surgeons, the laparoscopic approach can be performed efficiently, with operating times comparable with open repairs. We found no statistically significant difference in operative time between the two groups. Our data showed an average operative time of 34.16 minutes for the laparoscopic group and 40.17 minutes for the open group, suggesting that with experienced surgeons, the laparoscopic approach can be performed efficiently.

Another important aspect of hernia repair is the prevention of recurrence. Both laparoscopic and open sutureless techniques have demonstrated low recurrence rates, confirming their efficacy in preventing hernia reformation.[40,41] Although no recurrences were observed during the follow-up period in our study, it is important to note that long-term follow-up is essential to accurately assess recurrence rates, as recurrences may manifest several years after the initial procedure.[32]

Although laparoscopic hernia repair has many advantages, including reduced pain, faster recovery, and lower incidence of chronic pain, there are limitations. The need for general anesthesia makes it unsuitable for some patients. In addition, the initial cost of laparoscopic repair is higher due to the specialized equipment required. However, these costs may be offset by shorter hospital stays and faster recovery times, ultimately reducing the overall financial burden on health care systems.[36]

Limitations

The main limitations of our study include the relatively small sample size, the single-center nature of the research, and a follow-up period that could be extended to detect potential long-term recurrences. Despite these limitations, our findings, in line with the existing literature, support the use of sutureless laparoscopic hernia repair as a safe and effective option for the management of inguinal hernias, with significant advantages in terms of postoperative recovery and patient outcomes.

Conclusions

Sutureless hernia repair techniques are effective and safe options for the management of inguinal hernias. The laparoscopic approach offers superior results in terms of postoperative pain reduction and faster recovery. However, for patients who cannot undergo general anesthesia, the sutureless open technique offers a reliable alternative. Further studies with larger cohorts and longer follow-up are needed to confirm these results and improve long-term outcomes.

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Authors' Contributions

S.O.: Conceptualization (lead), writing—original draft (lead), formal analysis (lead), and writing—review and editing (equal). A.D.: Writing—review and editing (equal). F.C.: Writing—review and editing (equal). A.A.G.Z.: Writing—review and editing (equal). M.U.: Writing—review and editing (equal). G.C.: Writing—review and editing (equal).

Disclosure Statement

All authors declare that they have no conflicts of interest.

Funding Information

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