

# Complications in single-incision laparoscopic surgery transabdominal preperitoneal (SILS-TAPP) for inguinal hernia

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## ABSTRACT

**Objective:** Single-incision laparoscopic surgery transabdominal preperitoneal (SILS-TAPP) inguinal hernia (IH) repair represents an innovative advancement in minimally invasive surgical techniques. However, there have been concerns about the complication rate of this technique. We aimed to systematically review the complications of SILS-TAPP in detail. **Methods:** We comprehensively searched the published literature between 1980 and 2022 on Pubmed, Embase, Scopus, Web of Science, and Proquest. Studies of IH patients aged < 18 who underwent SILS-TAPP were included. The results must include the intraoperative and/or postoperative complications rate of surgery. Studies not in English, studies of patients who underwent another surgery apart from hernia repair, and review articles were excluded. The abstract and full-text screening were done. **Results:** Primary search on a major database platform gained 348 records of articles. After screening, 9 studies were included. Nine studies recruited 1561 patients. Men were dominant. Recurrent IH accounted for about 4%. Two studies reported using specialized laparoscopic instruments (Roticulator), while the other eight used conventional instruments. No major intraoperative complications were reported. Blood loss was minimal. There was only one case wherein an additional trocar was placed. Postoperative complications were observed in about 5% of cases, including seroma, hematoma, urinary retention, port site infection, ileus, foreign body sensation, and port site hernia. Recurrence was rare, accounting for about 0.3%. **Conclusion:** Complications of SILS-TAPP are not frequent and mild. The recurrent rate is small. Therefore, SILS-TAPP can be a good alternative for open and laparoscopic hernia repair.

**Keywords:** Complication, Inguinal hernia, Single-incision laparoscopic surgery transabdominal preperitoneal (SILS-TAPP)

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## INTRODUCTION

Single-incision laparoscopic surgery (SILS) represents an innovative advancement in minimally invasive

surgical techniques, aimed at reducing invasiveness and improving the cosmetic outcomes of traditional laparoscopic procedures. When applied to transabdominal preperitoneal (TAPP)

hernia repair, SILS-TAPP combines the benefits of reduced postoperative pain, quicker recovery times, and minimal scarring with the added advantage of utilizing a single incision [1-3]. This approach not only enhances the aesthetic appeal but also potentially minimizes the risks associated with multiple entry points, positioning SILS-TAPP as a promising alternative to conventional multi-port laparoscopic hernia repairs [2, 3].

Despite its growing popularity and potential benefits, SILS-TAPP hernia repair is not without its risks. The unique constraints of operating through a single incision can complicate visualization and maneuverability, leading to technical difficulties that may increase the likelihood of intraoperative and postoperative complications. Issues such as port-site hernias, infection, and recurrence rates require careful consideration [2-5]. Additionally, the limited working space and instrument crowding inherent in single-incision procedures can challenge even experienced surgeons, potentially impacting the precision and efficacy of the repair [6].

This study aimed to explore these complications in detail, providing valuable insights into the risks and technical hurdles associated with SILS-TAPP hernia repair. By examining the specific challenges posed by this technique, including the potential for increased operative time and the learning curve associated with mastering single-incision procedures, we seek to inform surgical practice and improve patient outcomes. Understanding these factors is crucial for surgeons to better prepare for and mitigate potential complications, ultimately enhancing patient safety and

advancing the field of minimally invasive hernia repair.

## METHODS

### Search strategy

We comprehensively searched the published literature between 1980 and 2022 on Pubmed, Embase, Scopus, Web of Science, and Proquest. The search terms were " Inguinal hernia" AND "hernia repair" AND "single incision laparoscopic surgery" AND "TAPP" AND "complication". Details of the search strategy are shown in the Supplementary.

### Eligible criteria

Studies of IH patients aged < 18 who underwent SILS-TAPP were included. The results must include the intraoperative and/or postoperative complications rate of surgery. Studies not in English, studies of patients who underwent another surgery apart from hernia repair, and review articles were excluded.

### Screening of studies

The records were imported to Endnote for title screening, wherein irrelevant studies were removed. The abstract and full-text screening were done.

### Surgical techniques

General anesthesia was applied. The patient was placed in a Trendelenburg position, tilting to the opposite side of the hernia side. A 1.5-2.0-cm incision was made trans- or para-umbilically. Then the rectus fascia was opened. SILS-port was placed. Abdominal pressure was set at about 12-15 mmHg. A laparoscope of 30 degrees was usually used. Surgeons can use articulators or conventional laparoscopic instruments according to their surgical familiarity. However, many authors suggested that

manipulation with a rotulator is difficult and weak.

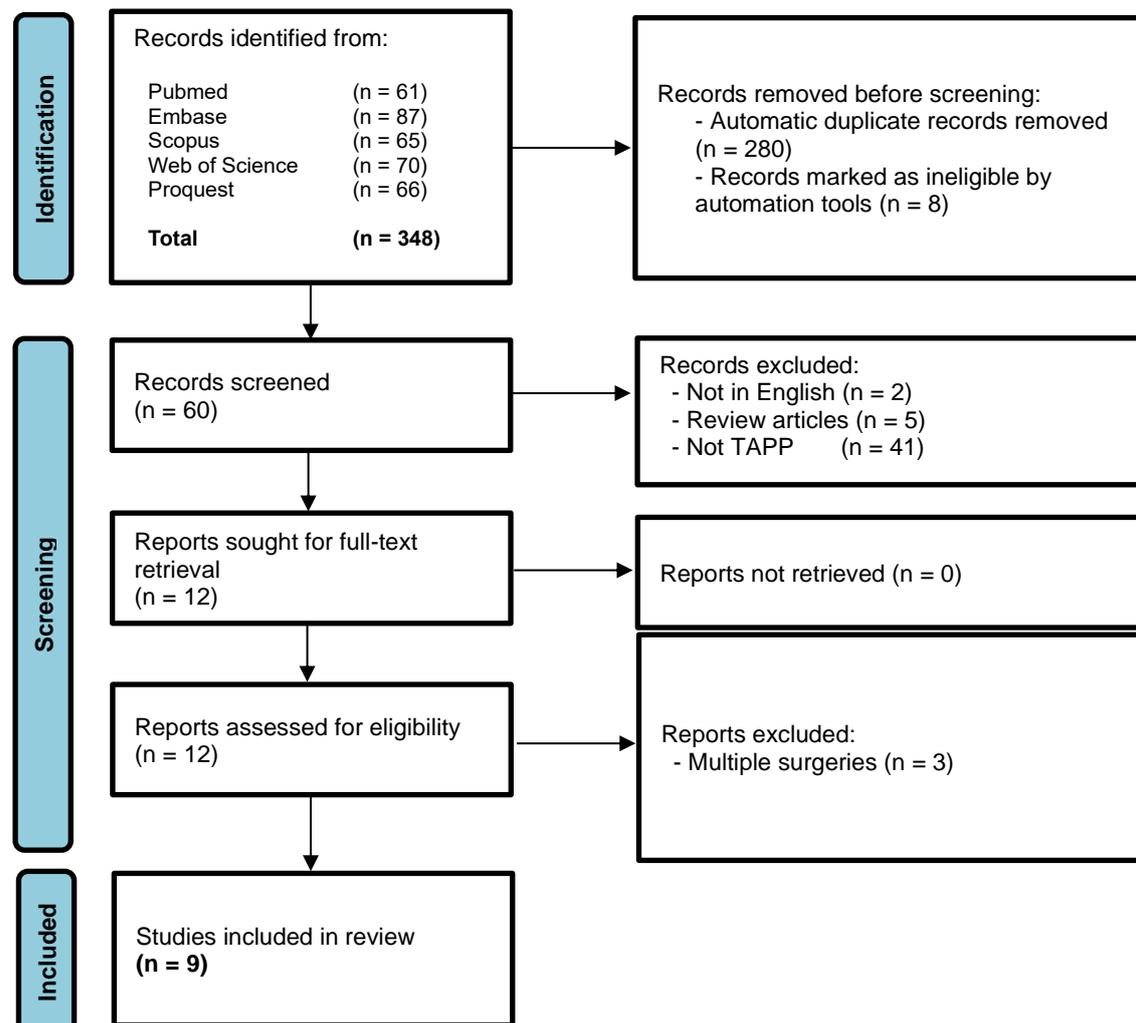
Inguinal hernia content was identified via the vision of the laparoscope. If adhesion occurred, adhesiolysis was done. The peritoneum was opened above the inguinal ring from the medial umbilical ligament to the anterior superior iliac spine. The peritoneal fold descended, and the inferior epigastric vessel was identified. After that, meticulous dissection was done to expose the myopectineal orifice, internal inguinal ring, Cooper’s ligament, iliopubic tract, vas deference, testicular vessel.

The hernia sac was dissected carefully. The indirect and combined hernia sacs were

ligated and cut, while the direct hernia sac was pulled back to the abdominal cavity. The treatment for the hernia sac was different from surgeon to surgeon. The peritoneum was dissected widely according to the mesh’s size.

The mesh was introduced to the abdomen and spread to cover the myopectinal orifice and internal inguinal ring. Then, the mesh was fixed to the Cooper ligament, iliopubic tract, rectus muscle, and transversus abdominis muscle using Protack or suture. The peritoneum was closed using Protack or continuous suture. Finally, the port was removed, and the abdominal incision was closed.

## RESULTS



*Figure 1. The PRISMA flow diagram of the included studies*

A primary search on a major database platform gained 348 records of articles. After checking for duplication and ineligible articles by automation tools, 288 records were excluded. Afterward, 51 articles were removed due to the following reasons: not in English, review articles, not TAPP surgery, and studies of multiple surgeries (Figure 1). Finally, 9 studies were included in this review. **(Figure 1)**

Nine studies recruited 1561 patients who underwent SILS TAPP for unilateral, bilateral, or recurrent IH. Men were dominant. Recurrent IH accounted for about 4%. Two studies reported using specialized laparoscopic instruments (Roticulator), while the other eight used conventional instruments. Fixation of prolene mesh was done using Protack in most cases. Peritoneum closure suture was done using a track of continuous suture. No major intraoperative complications were reported. Blood loss was minimal. There was only one case wherein an additional trocar was placed. Postoperative complications were observed in about 5% of cases, including seroma, hematoma, urinary retention, port site infection, ileus, foreign body sensation, and port site hernia. Recurrence was rare, accounting for about 0.3%. **(Table 1)**

**Table 1. Characteristics of included studies**

No.	Study	Year	n	Age	Mean operation time (mins)	Instrument	Mesh fixation	Complication	Recurrence
1.	Rahman et al., 2010	2010	1	39	NA	Rotulator	Tack	Non	NA
2.	Sinha et al., 2011	2011	67	38.6	42.8 (32-61) 51.7(42-81)	Conventional	Tack or Suture	Port site discharge 3	NA
3.	Takayama et al., 2014	2014	6	55	NA	Rotulator	Tack	Non	NA
4.	Sinha et al., 2015	2015	183 (207 hernias)	41.4	38.3/53.2 for unilateral/bilateral using tack 42.8/62.7 for unilateral/bilateral using suture		Tack or Suture	-Port site discharge 8 -Port site infection 1	2
5.	Ece et al., 2017	2017	60	50.7 ± 10.1	38.7±9.2	Conventional	Tack	-Wound infection 1 -Seroma 2 -Hematoma 1 -Retention 6 -Ileus 1 -Port site hernia 3	0
6.	Chen et al., 2023	2023	177	70.3 ± 6.2	28.6 ± 4.2	Conventional	V loc	-Intestinal injury 1 -Seroma 9 (5.1%) -Retention 10 (5.6%) -Foreign body sensation 7(4%)	1
7.	Jiao et al., 2023	2023	966 (1054 hernias)	58.0± 17.8	35.5±17.0 (unilateral IH) 51.9±25.5 Bilateral (IH)	Conventional	V loc	-Seroma 156(14.8%) -Hematoma 1(0.1%) -Retention 22 (1.1%) -Infection 5(0.5%) -Chronic pain 9 (0.9%)	1(0.1%)

8.	Van et al., 2023	2023	10	48.5	65(45-95)	Conventional	Tack	Non	Non
9.	Van et al., 2023	2023	Non: 63 Elderly 28	45.0±14.4 71.8±5.1	44.1±14.7 49.8±19.7	Conventional	Tack	-Inguinoscrotal chronic pain 3 -Spermatic cord pain 1	1 in elderly group

NA: not available, mean operation time was shown as mean±SD or median(range)

## DISCUSSIONS

IH repair is a common surgery worldwide with about 20 million procedures performed each year. Laparoscopic hernia repair has been popularized as it offers similar surgical outcomes but faster recovery and fewer complications than open surgery. SILS-TAPP is an option in laparoscopic treatment for IH. However, there are not many studies of SILS-TAPP that were published. The actual rate of complications in laparoscopic hernia repair is likely underestimated. Hernia repair, being one of the most common elective surgeries, exemplifies a seemingly simple procedure that any surgeon can perform. However, it can lead to numerous unforeseen complications that might worsen a patient's quality of life. Despite the evident advancements in hernia treatment, the topic has grown more complex.

The use of carbon dioxide insufflation can potentially impact the acid-base balance, potentially exacerbating existing intraperitoneal sepsis or inflammation [7]. Also, the increased intraperitoneal pressure during TAPP could bring negative effects on cardiovascular function by increasing after load, venous assistance and systemic pressure. In patients with high-risk cardiac conditions, the impact of CO<sub>2</sub> pneumoperitoneum is more noticeable compared to individuals with normal cardiac function [8]. Therefore, the longer the operation time, the more likelihood the complication increases. The operation time of SILS TAPP was thought to be longer than conventional TAPP because of its challenges in the manipulation of curved surgical instruments. In our review, the mean operation time of SILS TAPP ranged from

about 30 to 60 minutes. This was comparable with conventional TAPP or even open surgery [9].

During the dissection of hernia content, intraoperative complications may occur. Poor knowledge of anatomy, failure to recognize structures, improper use of energy sources, impatience, lack of skills, or challenging dissections (such as those following previous surgeries) can lead to injuries of major vessels, nerves, bowel, bladder, spermatic cord, or spermatic vessels [10]. Vessels at risk are inferior epigastric, iliac, and spermatic vessels that are susceptible to injury from the trocar, during dissection, or by fixation devices. During dissection of the landing zone, the genital branch of the genitofemoral nerve, the lateral femoral cutaneous nerve, and the femoral nerve can be directly cut, damaged by coagulation, or injured by fixation devices. Depending on the penetration depth of the device, it can also harm the ilioinguinal or iliohypogastric nerve. Although major nerve injuries following laparoscopic hernia repair have been reported, the risk of such complications is very low. The "triangle of pain," located lateral to the spermatic vessels and below the iliopubic tract, is an area where nerves are at risk of injury. Reinhold's excellent anatomical study has expanded this area to about 1.5–2 cm above the iliopubic tract. Sensory changes after a TAPP (Transabdominal Preperitoneal) repair occur at a rate approximately ten times lower than after an open repair [11]. Visceral injuries are rare in SILS-TAPP.

Seroma is the most frequent early postoperative complication of SILS-TAPP. We found that the rate of seroma was as high as 15% in a large series of 996 patients [2].

The larger the hernia sac, the higher the likelihood of developing a seroma. In large indirect hernia sacs, complete retraction is recommended but may lead to a higher incidence of hematomas and could compromise blood supply to the testicle. Transecting the indirect sac and leaving the distal portion open is associated with a higher incidence of seromas and can later result in the development of a pseudo hydrocele. Fixing the distal portion to the abdominal wall, lateral to the epigastric vessels, appears to help prevent the occurrence of seromas [12] [ref]. For larger direct hernias, the incidence of seromas can be significantly reduced by inverting the transversal fascia and fixing it to Cooper's ligament. This procedure not only reduces the dead space for seroma formation but also prevents the potential dislocation of the mesh into the previous hernia space. Inversion of the transversal fascia is statistically associated with a lower incidence of postoperative seroma and does not increase postoperative pain [13]. Port site-related complications such as infection or hernia were rare [2, 5, 6]. Meticulous closure suture of the fascia could reduce the port site hernia.

Recurrence following SILS-TAPP was scant, about less than 0.3%. It was reported one or two cases in several series [2, 3, 6, 14]. Due to the low incidence of recurrence, the actual cause of recurrence is unknown. However, it was attributed to issues of mesh and mesh placement. The recommended mesh size for TAPP repair is 15 × 10 cm or larger. Using smaller meshes is currently the most important cause of hernia recurrence. Initially, mesh slits were intended to prevent possible mesh dislocation, but they actually increased the recurrence rate. Leibl's study demonstrated that both small mesh size and

the presence of a slit in the mesh increased the risk of recurrence [15]. Heikinnen changed his TAPP repair strategy from using Surgipro 6 × 10 cm mesh to Prolene 10 × 14 cm mesh, reducing his recurrence rate from 28% to 0% [16]. Felix found that out of six patients with chronic testicular pain, four had a keyholed mesh [17]. It is speculated that the slit might predispose the nerve to injury or chronic irritation from the mesh.

## CONCLUSIONS

Complications of SILS-TAPP are not frequent and mild. The recurrent rate is small. Therefore, SILS-TAPP can be a good alternative for open and laparoscopic hernia repair.

## CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

## SOURCES OF FUNDING

None.

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