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# Evaluation of the Efficacy of Flat Mesh Tension-Free Hernioplasty in the Treatment of Inguinal Hernia

**Haibo Zhang***

Balihan Town Central Health Center, Ningcheng County, Chifeng City, Inner Mongolia Autonomous Region, China

**Author to whom correspondence should be addressed.*



**Abstract:** *Objective*: To explore and analyze the clinical efficacy of flat mesh tension-free hernioplasty in the treatment of patients with inguinal hernia. *Methods*: A total of 60 patients with inguinal hernia were included and equally divided into an observation group (30 cases, flat mesh tension-free hernioplasty) and a control group (30 cases, mesh plug tension-free hernioplasty) based on differences in surgical plans. The visual analog scale (VAS) for postoperative pain, inflammatory markers (C-reactive protein, white blood cell count), and complication rates were compared between the two groups. *Results*: At 24 and 48 hours postoperatively, the VAS scores in the observation group were significantly lower than those in the control group ($P < 0.05$). At 24 hours postoperatively, the levels of CRP and WBC were also lower in the observation group ($P < 0.05$). The complication rate was slightly lower in the observation group ($P > 0.05$). *Conclusion*: Flat mesh tension-free hernioplasty for inguinal hernia can alleviate postoperative pain and suppress inflammatory responses, with fewer complications, making it suitable for promotion at primary healthcare facilities.

**Keywords:** Clinical efficacy; Flat mesh tension-free hernioplasty; Inguinal hernia; Mesh plug tension-free hernioplasty; Postoperative pain

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## 1. Introduction

Inguinal hernia is a common condition in general surgery, primarily caused by a decrease in the structural strength of the abdominal wall aponeurosis layer or prolonged elevation of intra-abdominal pressure, leading to the protrusion of intra-abdominal tissues through the defect [1]. Currently, surgical treatment remains the only curative option. Traditional tension repairs, which require high levels of postoperative analgesia and carry a significant risk of recurrence, are gradually being replaced by tension-free techniques.

Tension-free repair involves the use of artificial meshes to close fascial defects, with flat mesh coverage and mesh plug placement being the two commonly used clinical techniques. Although laparoscopic and minimally invasive concepts are rapidly gaining popularity in hernia surgery, open surgery remains the primary treatment

modality in primary healthcare facilities due to limitations in equipment availability and operational experience [2].

In view of this, this study included 60 patients with primary unilateral inguinal hernia to randomly compare the therapeutic effects of mesh-patch tension-free repair and plug-mesh tension-free repair in such patients, with the specific content reported as follows.

## 2. Materials and methods

### 2.1. General information

A total of 60 male patients admitted from May 2022 to May 2025 were included and evenly divided into two groups (30 cases each) based on differences in surgical methods. The observation group had an average age of (56.67 ± 8.23) years, with 24 cases of indirect inguinal hernia and 6 cases of direct inguinal hernia, and a disease duration of (2.78 ± 1.12) years. The control group had an average age of (57.57 ± 7.67) years, with 23 cases of indirect inguinal hernia and 7 cases of direct inguinal hernia, and a disease duration of (2.89 ± 1.11) years. There were no statistically significant differences in baseline data between the two groups ($P > 0.05$), indicating comparability. This study was approved by the hospital's ethics committee.

The inclusion criteria are as follows:

(1) Diagnosis of inguinal hernia confirmed by both physical and ultrasound examinations [3];

(2) Age between 18 and 75 years old;

(3) Scheduled to undergo elective open surgery;

(4) Voluntarily signed an informed consent form.

Exclusion criteria:

(1) Signs of incarceration or strangulation;

(2) Coexisting coagulopathy or active infection;

(3) Massive abdominal wall defects or recurrent hernia;

(4) Coexisting severe cardiac, hepatic, or renal dysfunction.

### 2.2. Methods

Continuous epidural anesthesia was used for both groups, with the specific procedure involving puncturing the L2-3/L3-4 interspace and controlling the anesthetic plane within the range of ≤ T10. The patient was placed in a supine position, and after disinfection and draping, an oblique incision approximately 4–6 cm in length was made from 2 cm above the midpoint of the inguinal ligament to the pubic tubercle. The layers were then incised until the external oblique aponeurosis was reached, and after separation, the internal and external rings of the inguinal canal were exposed while protecting the relevant nerves. Next, the spermatic cord was freed to a length of ≥ 2 cm, and the hernia sac was explored and freed to the extraperitoneal fat layer (large hernia sacs were transected 3 cm from the hernia ring, and the proximal end was returned to the abdomen).

For the observation group (Lichtenstein Tension-Free Hernioplasty), an American Bard 10×15 cm polypropylene mesh (376015) was used. After trimming, the mesh was placed to cover 1.5–2 cm medial to the pubic tubercle, extend 2 cm lateral to the internal ring, and overlay 1–1.5 cm of the transverse abdominal muscle arch. The mesh was positioned posterior to the spermatic cord and sutured to the pubic aponeurosis (2–3 stitches), transverse abdominal muscle arch (continuous suture), and inguinal ligament (interrupted sutures, spaced 0.5–1 cm apart) using 2-0 Ethicon non-absorbable sutures, ensuring no excessive tightening or shrinkage. The spermatic

cord was repositioned, and the external oblique aponeurosis was closed with 4-0 Ethicon absorbable sutures (VICRYL). The incision was closed layer by layer and dressed.

For the control group (Plug-and-Patch Hernioplasty), an American Bard mesh kit (375015, consisting of a conical plug and a flat mesh) was used. The transversalis fascia was incised, and the hernia sac was reduced. A conical plug was placed into the hernia ring (with the tip directed towards the abdomen), and the base of the plug was sutured to the edge of the hernia ring using 2-0 sutures (4–6 stitches, spaced 0.8–1 cm apart). A flat mesh was placed posterior to the spermatic cord (covering the edge of the plug by ≥ 1 cm) and sutured in the same manner as the observation group. The incision closure steps were identical to those in the observation group.

## 2.3. Observation indicators

### 2.3.1. Postoperative pain VAS score

Pain was recorded at 6 h, 24 h, and 48 h postoperatively using the Visual Analog Scale (VAS), where 0 indicates no pain and 10 indicates unbearable severe pain.

### 2.3.2. Inflammatory indicators

Peripheral venous blood samples were collected once 24 h before and once 24 h after surgery. C-reactive protein (CRP, reference range 0–10 mg/L) was measured using immunoturbidimetry, and white blood cell count (WBC, reference range 4–10×$10^9$/L) was determined using an automated hematology analyzer during the same period.

### 2.3.3. Incidence of complications

Patients were followed up for 3 months postoperatively to record complications such as incision redness and swelling, urinary retention, foreign body sensation from the mesh, and persistent pain.

## 2.4. Statistical methods

Comparisons were made using SPSS 23.0 software. For categorical data, percentages (%) and the $\chi^2$ test were employed for analysis. For measurement data conforming to a normal distribution, the mean (mean ± SD) and t-test were used. A statistically significant difference was considered when $P < 0.05$.

# 3. Results

## 3.1. Comparison of VAS scores

As shown in **Table 1**, the VAS scores of the observation group at 6 hours, 24 hours, and 48 hours postoperatively were all lower, with $P < 0.05$.

**Table 1.** Comparison of VAS scores at different time points postoperatively between groups (mean ± SD)

| Group | n | 6h postop | 24h postop | 48h postop |
|---|---|---|---|---|
| Observation group | 30 | 3.42 ± 0.37 | 2.43 ± 0.21 | 1.23 ± 0.14 |
| Control group | 30 | 4.45 ± 0.34 | 3.55 ± 0.19 | 2.44 ± 0.18 |
| t-value | | 11.227 | 21.662 | 29.063 |
| *P*-value | | 0.001 | 0.001 | 0.001 |

## 3.2. Comparison of inflammatory markers

As presented in **Table 2**, the CRP and WBC values of the observation group at 24 hours postoperatively were both lower, with $P < 0.05$, although there was an increasing trend compared to preoperative levels, with $P < 0.05$.

**Table 2.** Comparison of inflammatory markers between groups (mean ± SD)

| Group | n | CRP (mg/L) | | WBC ($10\times10^9$/L) | |
|---|---|---|---|---|---|
| | | Preoperative 24h | Postoperative 24h | Preoperative 24h | Postoperative 24h |
| Observation group | 30 | 5.21 ± 1.18 | 10.78 ± 1.12 | 6.45 ± 1.34 | 9.21 ± 1.15 |
| Control group | 30 | 5.45 ± 1.21 | 13.56 ± 1.17 | 6.56 ± 1.25 | 12.67 ± 1.22 |
| t-value | | 0.778 | 9.401 | 0.329 | 11.304 |
| *P*-value | | 0.440 | < 0.001 | 0.744 | < 0.001 |

## 3.3. Comparison of complications

As indicated in **Table 3**, the incidence of complications in the observation group was lower, but there was no significant difference between the groups, with $P > 0.05$.

**Table 3.** Comparison of complications between groups [n (%)]

| Group | n | Incisional redness/ swelling | Urinary retention | Mesh foreign body sensation | Chronic pain | Total incidence |
|---|---|---|---|---|---|---|
| Observation group | 30 | 1 (3.33%) | 0 (0.00%) | 0 (0.00%) | 0 (0.00%) | 1 (3.33%) |
| Control group | 30 | 0 (0.00%) | 0 (0.00%) | 1 (3.33%) | 2 (6.67%) | 3 (10.00%) |
| $\chi^2$ value | | | | | | 1.071 |
| *P*-value | | | | | | 0.301 |

# 4. Discussion

With the continuous development of surgical techniques, tension-free hernia repair has completely replaced traditional tension repair as the clinical preference due to its advantages such as lower postoperative recurrence rates and relatively faster recovery. However, there is still controversy regarding the choice between the two commonly used tension-free techniques, namely, the plug-and-patch and the flat-mesh techniques, in terms of efficacy and safety. According to recent clinical data statistics, the plug-and-patch tension-free hernia repair, which was initially believed to enhance hernia ring repair strength with the aid of a conical plug, has been widely applied in the treatment of complex hernias [4]. However, issues such as postoperative pain and foreign body reactions have gradually emerged [5].

The flat-mesh tension-free hernia repair, due to its simple operation and minimal disruption to anatomical structures, has seen an increasing application rate in primary hospitals and among patients seeking rapid recovery. However, data on its efficacy in high-risk populations remains relatively scarce. This study conducted a retrospective analysis of the clinical data of 60 patients with inguinal hernia to compare the therapeutic effects of two surgical procedures. The results demonstrated that the observation group had advantages in terms of postoperative pain relief and control of inflammatory responses, with a decreasing trend in the incidence of

complications.

The results of this study indicated that at 24 and 48 hours postoperatively, the VAS scores of the study group were significantly lower than those of the control group ($P < 0.05$). The core mechanism underlying this difference is directly related to the intervention methods of the two surgical procedures on the anatomical structure of the abdominal wall. From an anatomical perspective, the inguinal region is traversed by the iliohypogastric nerve, the ilioinguinal nerve, and the genital branch of the genitofemoral nerve. Damage or irritation to these nerves is a primary cause of postoperative pain [6]. The flat mesh tension-free hernia repair procedure employs a "paving" method to fix the mesh, ensuring a high degree of adherence between the mesh and the abdominal wall tissue. During suturing, intermittent or continuous suturing is performed along tough tissues such as the transverse abdominal muscle aponeurosis and the inguinal ligament, which can prevent excessive traction or suture compression on the nerve pathways [7].

In contrast, during the mesh plug hernia repair procedure, the conical plug must be fixed at the edge of the hernia ring, which happens to be a critical area where the ilioinguinal nerve traverses. The physical compression caused by the plug may temporarily disrupt nerve conduction function, resulting in persistent dull pain after surgery. During the process of fitting the plug into the hernia ring, if the hernia ring diameter is small, forced dilation of the hernia ring is required to insert the plug, which can easily cause damage to the fascial tissue surrounding the hernia ring and exacerbate the pain response [8].

Meanwhile, postoperative inflammatory responses represent a stress reaction of the body to surgical trauma, and their intensity directly reflects the magnitude of surgical trauma and the state of the body's recovery. In this study, the CRP and WBC levels of the observation group at 24 hours postoperatively were lower than those of the control group ($P < 0.05$), indicating that the flat mesh tension-free hernia repair procedure causes less traumatic stress to the body and results in milder inflammatory responses.

From the perspective of pathophysiological mechanisms, surgical trauma activates the body's innate immune response, prompting inflammatory cells such as neutrophils and macrophages to gather at the site of the trauma. These cells release inflammatory factors, which induce the liver to synthesize CRP [9]. Simultaneously, surgical trauma stimulates the bone marrow to release white blood cells into the bloodstream. The plug-and-patch tension-free hernioplasty, involving procedures such as hernia ring separation and filler placement, entails a broader range of tissue dissection and a larger traumatic area. This leads to more intense activation of inflammatory cells and release of inflammatory factors. On the other hand, the flat-mesh tension-free hernioplasty is a simpler procedure that only requires limited separation of the posterior wall of the inguinal canal, significantly reducing the traumatic area and the stimulation to the body's immune system. Consequently, the elevation of CRP and WBC levels is more gradual.

Additionally, our study results showed that the complication rate in the observation group was slightly lower than that in the control group ($P > 0.05$). Although this difference did not reach statistical significance, it still holds some clinical reference value. Regarding the types of complications, the control group primarily experienced complications such as persistent seroma, incision pain, and a sensation of foreign material from the mesh. Conversely, the observation group mainly experienced mild incision redness and swelling. Analyzing the reasons, although the filler used in the plug-and-patch tension-free hernioplasty has relatively good compatibility with surrounding tissues as a foreign body, it can still trigger a foreign body reaction in local tissues, leading to seroma formation.

The presence of the filler may also increase the incidence of a sensation of foreign material from the mesh after surgery [10]. By contrast, the flat-mesh tension-free hernioplasty uses a smaller mesh that fits more closely with the tissue, resulting in a milder foreign body reaction and lower incidence rates of complications such as

seroma and a sensation of foreign material from the mesh.

### 5. Conclusion

In summary, employing the flat-mesh tension-free hernioplasty for inguinal hernia treatment can effectively alleviate postoperative pain, reduce the degree of inflammatory response, and present a lower risk of complications. Therefore, it is worthy of clinical promotion and application. Future research should focus on prospective, large-sample, and multi-center designs, incorporating stratified analysis based on individual patient differences to clarify the suitable population for the flat-mesh tension-free hernioplasty and its long-term treatment outcomes. This will provide more robust evidence to support the precise treatment of inguinal hernia.

## Disclosure statement

The author declares no conflict of interest.

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