A prospective study on femoral hernia repair: is the inguinal better than the infrainguinal approach?

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ABSTRACT

Background: Femoral hernia repair has various surgical methods. However, controversy still exists regarding the best method for management. This study aimed to compare the infrainguinal with the inguinal approach in the treatment of femoral hernias.

Materials and methods: Eighty patients with primary unilateral femoral hernias were prospectively randomized to either the infrainguinal (n = 40) or inguinal approach groups (n = 40). Patient demographics, operative time, duration of hospital stay, postoperative complications, and recurrence rate were recorded.

Results: There were no statistically significant differences between both study groups with respect to the patients’ demographics and associated comorbidities. Regarding inpatient outcomes, there were no differences between the infrainguinal and inguinal approach groups concerning the postoperative duration of stay (P = 0.248), urinary retention (P = 0.494), superficial wound infection (P = 0.494), seroma (P = 0.615), foreign body sensation (P = 0.615), and chronic pain (P = 0.359). However, total complications were encountered in 3 patients (7.5%) in the infrainguinal approach group compared to 11 patients (27.5%) in the inguinal approach group (P = 0.037). Also, the mean operative time was significantly shorter in the infrainguinal approach group compared to that in the inguinal group (P < 0.001). Throughout the 15 mo median follow-up duration, there was no recurrence in the inguinal approach group and one (2.5%) recurrence in the infrainguinal approach group (P = 1.000).

Conclusions: In patients undergoing elective primary femoral hernia repair, the infrainguinal approach has a similar clinical curative effect to that of the inguinal approach. However, the former has the advantages of simple operation, short operation time, and fewer complications.

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**Introduction**

Femoral hernias account for 2%-4% of groin hernias\(^1\) but are clinically crucial because they are associated with a higher rate of emergency surgery and bowel resection.\(^2,\,4\) Gallegos et al. relate that the cumulative probability of strangulation for inguinal hernias was only 2.8% after 3 mo, then rising to 4.5% after 2 y. However, for femoral hernias, the cumulative probability of strangulation was 22% at 3 mo and 45% at 21 mo.\(^5\) Dahlstrand et al. reported that 10% of emergency patients with a femoral hernia were on the waiting list before surgery and, 30% of them were reported to be on the list for less than 1 mo.\(^6\) Thus, once the diagnosis of a femoral hernia is confirmed, elective surgery should be advised.\(^6,\,9\)

The traditional suture is the tension repair of tissue to tissue. The classic operation is a McVay operation with a recurrence rate of up to 10%-15%.\(^2,\,10,\,11\) Tension-free herniorrhaphy overcomes the shortcomings of the traditional techniques to a large extent. Since Lichtenstein and Shore started using the plug to treat femoral hernia in 1968, plug insertion into the femoral canal has become a widely accepted technique in femoral hernia surgery.\(^12\) The infrainguinal plug technique has always been a favorite for its simplicity, safety, and remarkable effectiveness.\(^13,\,14\) Despite its utility, mesh plug repair has been reported to be associated with a substantial recurrence rate, a postoperative sensation of a foreign body in the inguinal region, and seromas.\(^15\) In recent decades, the use of the inguinal approach in preperitoneal repair of femoral hernias is increasing. A report by Zandi et al. indicated satisfactory results using this technique for femoral hernia repair.\(^16\) However, this operation has its shortcomings because it is technically difficult and time-consuming and disrupts an otherwise normal floor on the inguinal canal.\(^11\) Thus, until now, although many techniques exist for hernia repair, controversy still exists as to the best management of femoral hernias.

Owing to the relatively low incidence of femoral hernias, the accumulation of a large number of clinical cases is difficult; thus, few prospective studies have analyzed the effectiveness of different repair techniques.\(^15,\,17\) In this prospective study, we compared the outcomes of the infrainguinal and inguinal approaches in the treatment of primary unilateral femoral hernias.

**Materials and methods**

**Patient population and study design**

The study was approved by the ethics committees of West China Hospital, Sichuan University. Informed consents were obtained from all patients who agreed to participate in the study. Patients with bilateral, recurrent, and emergency femoral hernias were excluded (Figure). Data regarding age, sex, body mass index (BMI), and associated comorbidities were obtained from all patients. Following preoperative evaluation and preparation for surgery, patients were randomly assigned to either the infrainguinal approach group (40 patients) or inguinal approach group (40 patients). Randomization was performed according to the random number table. Randomization and patients’ allocation in either group were managed by an independent observer. The independent observer also measured the operative time in the present study. The study was conducted at the West China Hospital, Sichuan University, from May 2016 to December 2017.

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**Fig** - Patient flow diagram.
Operative technique

The infrainguinal approach group used the ULTRAPRO Plug (UPP, Ethicon, Norderstedt, Germany). The inguinal approach group used the ULTRAPRO Hernia System (UHS, Ethicon, Norderstedt, Germany). Local anesthesia was used in all procedures, and all operations were performed by the same team.

Infrainguinal approach group: After the skin and subcutaneous tissue were dissected, the hernial sac was exposed closely beneath the inguinal ligament. Isolated the hernial sac and returned to abdominal cavity if the hernia ring was large enough. In most cases, the hernia rings were too narrow to allow reduction of the sac; in these cases, it was necessary to enlarge the ring by partially slitting the inguinal ligament with forceps underneath the inguinal ligament (the inguinal ligament was transected in 23 of 40 patients with irreducible hernias). After reducing the sac, a UPP was placed through the femoral canal using forceps. The anchor of the UPP should be unfolded at the inner surface of the femoral ring before fixing the rim to the inguinal ligament, pectineal ligament, and Gimbernat ligament with 3-0 absorbable suture. The femoral vein and artery should be carefully protected during the operation and suture. The excessive rim of the plug can be trimmed to improve postoperative comfort. Then, subcutaneous and intradermal tissue was sutured.

Inguinal approach group: After the skin, subcutaneous tissue, and aponeurosis of external abdominal oblique muscle were incised, the spermatic cord or round ligament was dissected and pulled inferiorly and laterally. The preperitoneal space was exposed after the transverse fascia was incised medially to the inferior epigastric artery (Hesselbach’s triangle). The hernial sac was found in the femoral ring and pulled out from the femoral canal. If reduction of the hernial sac was difficult, the sac was pushed back into the femoral canal or ring inferior to the inguinal ligament. If a hernia was irreducible, then the inguinal ligament anterior to the femoral ring was incised to enlarge the femoral ring, allowing reduction. (The inguinal ligament was transected in 21 of 40 patients with irreducible hernias.) After complete reduction of a hernia, the wall of the hernial sac was pushed inferiorly with a finger to produce a preperitoneal space (region of the myopectineal orifice [MPO]) between the peritoneum and transverse fascia. The center of the transverse fascia was opened to a diameter 10 cm. A preperitoneal patch was then molded, curled, and folded and then unfolded at the inner surface of the femoral ring before fixing the rim to the inguinal ligament, pectineal ligament, and Gimbernat ligament with 3-0 absorbable suture. The femoral vein and artery should be carefully protected during the operation and suture. The excessive rim of the plug can be trimmed to improve postoperative comfort. Then, subcutaneous and intradermal tissue was sutured.

Table 1 – Patient demographic data.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Intrainguinal approach group (n = 40)</th>
<th>Inguinal approach group (n = 40)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>38 (95.0%)</td>
<td>35 (87.5%)</td>
<td>0.432</td>
</tr>
<tr>
<td>Male</td>
<td>2 (5.0%)</td>
<td>5 (12.5%)</td>
<td></td>
</tr>
<tr>
<td>Age (y)</td>
<td>68.8 ± 12.6</td>
<td>60.6 ± 11.3</td>
<td>0.235</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.1 ± 2.7</td>
<td>24.3 ± 2.5</td>
<td>0.172</td>
</tr>
<tr>
<td>Associated with increased abdominal pressure</td>
<td>3 (7.5%)</td>
<td>6 (15.0%)</td>
<td>0.481</td>
</tr>
<tr>
<td>Astriction</td>
<td>2</td>
<td>3</td>
<td>1.000</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary</td>
<td>1</td>
<td>3</td>
<td>0.615</td>
</tr>
<tr>
<td>Prostatic hyperplasia</td>
<td>0</td>
<td>1</td>
<td>1.000</td>
</tr>
<tr>
<td>Associated with cardiac/cerebrovascular diseases</td>
<td>8 (20.0%)</td>
<td>6 (15.0%)</td>
<td>0.770</td>
</tr>
<tr>
<td>Associated with diabetes</td>
<td>4 (10%)</td>
<td>3 (7.5%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Irreducible hernia</td>
<td>27 (67.5%)</td>
<td>25 (62.5%)</td>
<td>0.815</td>
</tr>
</tbody>
</table>

Statistical analysis

Data are presented as mean values ± standard deviation or as number and percent. All data analyses were performed with the Statistical Package for the Social Sciences (SPSS) version 18 software. Student’s t-test was used for continuous variables. The chi-squared and Fisher’s exact tests were used for categorical variables. All P values were two sided. A P value <0.05 was considered statistically significant.

Results

A total of 80 patients, 73 women (91.3%) and 7 men (8.7%), completed the study (40 in each group). Their ages ranged from 27 to 84 y with a median of 63 y. There were no statistically significant differences between the study groups with respect to age, sex, BMI (kg/m²), and associated comorbidities, as shown in Table 1.

There was also no statistically significant difference between both study groups with respect to the patients’ postoperative duration of stay (22.7 h versus 21.1 h, respectively, P = 0.248) (Table 2). As for the complications, the infrainguinal approach group encountered one case of seroma, one case of foreign body sensation, and one case of chronic pain, whereas the inguinal approach group encountered two cases of urinary retention, two cases of superficial wound infection, three
cases of seroma, three cases of foreign body sensation, and four cases of chronic pain (Table 2). For each complication listed above, there was no difference between the two groups. Meanwhile, the treatments of complications in both groups were the same and sufficient. Urinary retentions and superficial wound infections were resolved by urine catheterization and dressing changes and appropriate antibiotic administration guided by sensitivity studies, respectively. All seromas were treated within 2-4 wk with conservative treatments such as hot compresses. Foreign body sensation and chronic pain did not affect the normal activity of patients.

Although there was no difference when comparing each complication between the two groups, the total complication rate did not affect the normal activity of patients.

Furthermore, after a median follow-up of 15 mo (range 6-24 mo), there were no recurrences in the inguinal approach group and one (2.5%) recurrence in the infrainguinal approach group at 6 mo after primary repair (P = 1.000). The patient with recurrence was found to have newly developed direct hernias and treated by preperitoneal repair. Throughout the study period, no mesh had to be removed in both groups.

Discussion

In recent decades, the inguinal approach for preperitoneal repair of femoral hernias had satisfactory results. However, the main finding of the present study suggests that the infrainguinal approach has a similar clinical curative effect to that of the inguinal approach. More importantly, the infrainguinal approach has the advantages of simple operation, short operation time, and fewer complications.

In fact, the infrainguinal approach has been widely used in the past for the simple process and easy operation. However, this procedure using the mesh plug for femoral hernia repair did not reach the aim of fixing the original breakthrough of the transverse fascia above the femoral ring. Furthermore, the mesh plug needs to bear the brunt of the abdominal cavity outward pressure for a long time, which may cause plug migration and then hernia recurrence. Mesh plug may also result in an increase in foreign body sensation and infection.21,22 Because of the above reasons, the infrainguinal approach was not regarded as the best method to repair a femoral hernia.

With the concept of MPO, it is now accepted that weakness in the inguinal area and defects of the transverse fascia are the fundamental causes of hernias. The area of MPO lacks a muscular layer and only covered by a layer of the transverse fascia to sustain the abdominal pressure. Thus, abdominal contents will protrude when the area of MPO is weak or has a defect.19,20 In recent years, more and more surgical procedures tend to use the preperitoneal space to repair a femoral hernia by inguinal approach, namely, fixing the ring on the initial breakthrough of the abdominal transverse fascia to block the contents in the abdominal cavity from falling into the femoral canal.21,22 Besides, while repairing the femoral hernia, the posterior wall of the inguinal canal could be strengthened, which could theoretically reduce the occurrence of indirect and direct inguinal hernias and also can be used to repair multiple hernias in the inguinal region. However, problems exist as well, such that it is technically difficult and time-consuming and disrupts an otherwise normal floor of the inguinal canal.11

In this study, the UPP, which has a 3D double-layer structure, was used in the repair of a femoral hernia through the infrainguinal approach. The plug anchor stock may be placed on the preperitoneal space located inside the femoral tube, and the connector was used to stuff the femoral tube, and the margin of the plug was fixed along with the surrounding tissues. The transverse fascia was strengthened; at the same time, the plug closes the femoral ring and fills the femoral canal. At last, it completely blocks the way of the contents of the abdominal cavity project out and plays a trebling repair role. As a result, unlike the traditional mesh plug, the UPP improves the effect of the infrainguinal approach. Thus, it is even more important to compare the two approaches now. The most surprising findings reveal that the infrainguinal approach was more straightforward, and the overall complication rate was lower. We believe that the infrainguinal approach has the following advantages in femoral hernia repair: (1). No need of incising the inguinal canal during the operation. The operation time is so short that incising the skin and subcutaneous tissue can only reveal the hernial sac below the inguinal ligament. (2). As there is no need to incise the inguinal canal, the scope of the operation adopting the infrainguinal approach does not involve the iliohypogastric, ilioinguinal, and genitofemoral nerves, which makes the theoretical possibility of the occurrence of postoperative chronic pain and local numbness rare. (3). When the UPP is placed, it is not necessary to separate the preperitoneal space because its anchor is hard and can extend by itself after placement, which

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**Table 2 – Patient outcomes.**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Infrainguinal approach group (n = 40)</th>
<th>Inguinal approach group (n = 40)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation time (min)</td>
<td>14.9 ± 4.0</td>
<td>26.7 ± 3.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Postoperative duration of stay (h)</td>
<td>22.7 ± 6.4</td>
<td>21.1 ± 5.9</td>
<td>0.248</td>
</tr>
<tr>
<td>Urinary retention</td>
<td>3 (7.5%)</td>
<td>11 (27.5%)</td>
<td>0.037</td>
</tr>
<tr>
<td>Seroma</td>
<td>0 (0.0%)</td>
<td>2 (5.0%)</td>
<td>0.494</td>
</tr>
<tr>
<td>Foreign body sensation</td>
<td>1 (2.5%)</td>
<td>3 (7.5%)</td>
<td>0.615</td>
</tr>
<tr>
<td>Chronic pain</td>
<td>1 (2.5%)</td>
<td>4 (10.0%)</td>
<td>0.359</td>
</tr>
<tr>
<td>Recurrence</td>
<td>1 (2.5%)</td>
<td>0 (0.0%)</td>
<td>1.000</td>
</tr>
</tbody>
</table>
apparently reduces the difficulties of the operation and is easy to master and learn. Though the inguinal approach using the UHS patch to repair the pubic bone muscle hole area can fix both the femoral canal opening and posterior wall of the inguinal canal, the normal transverse fascia located in the inguinal region needs to be incised. Furthermore, the diameter of the patch is 10 cm, so it requires a more extensive space usually separated directly to place it in. Thus, surgeons who are technically not skilled may cause hematoma. However, the inguinal approach is more suitable in the following: (1) to detect a hernia in other parts of the inguinal region when the diagnosis is not definite; (2) to treat multiple inguinal hernias, and (3) to probe the contents of a hernia when a femoral hernia is strangulated.

Previous studies have reported that the recurrence and complication rates in femoral hernia repair using the mesh plug were higher than that in the preperitoneal space, which was inconsistent with this study. In their literature, the mesh plug group included four cases (10%) of recurrence. One of the cases which recurred on postoperative day 3 was due to misdiagnosis of inguinal hernia, and the other three cases were new direct groin hernias. Thus, all four cases do not calculate as femoral hernia recurrence. The same literature showed a higher incidence of foreign body sensation and seroma; however, the incidence rate is lower in this study, which may be related to the different materials used.

Some scholars also put forward that, since the upward, downward, and inner sides of the formal tube were surrounded by poor mobility ligaments (inguinal, comb pubic, and pit ligaments) and the lateral side was next to the femoral vein, the repair material filling the tube may cause oppression or damage to the femoral vein when adopting the infrainguinal approach in femoral hernia repair and even can secondarily result in venous thrombosis. A retrospective study including 121 patients with a femoral hernia treated by the infrainguinal approach with long-term follow-up in our center revealed that there was no patient who developed venous thrombosis. The clinical and animal experiments by Taylor et al. and Sulaimanov et al. also showed that the shrinkage and fibrosis of repair materials postoperatively did not cause compression and erosion to the femoral vessels. In this study, throughout the follow-up, there was no patient who developed venous thrombosis as well.

**Conclusion**

In patients undergoing elective primary femoral hernia repair, the infrainguinal approach has a similar clinical curative effect to that of the inguinal approach. However, the former has the advantages of simple operation, short operation time, and fewer complications.

**Acknowledgments**

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Authors’ contributions: Wenzhang Lei designed the study. Yanyan Xie, Dongyang Ma, and Yinghan Song performed the research and acquisition of data. Fusun Jian, Sen Zhang, and Anqiong Lu analyzed and interpreted the data. Yanyan Xie wrote the first draft and critically revised the article for important intellectual content. Wenzhang and Wang Yong supervised the study. Yanyan Xie and Yinghan Song have contributed equally to this study.

**Disclosure**

The authors reported no proprietary or commercial interest in any product mentioned or concept discussed in this article.

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