

## Recurrent Inguinal Hernia after Tension-free Repair

Katsuhito SUWA<sup>1</sup>, Ken HANYU<sup>1</sup>, Toshiaki SUZUKI<sup>1</sup>, Shintaro NAKAJIMA<sup>2</sup>,  
Tomoyoshi OKAMOTO<sup>1</sup>, Nobuo OMURA<sup>2</sup>, and Katsuhiko YANAGA<sup>2</sup>

<sup>1</sup>Department of Surgery, The Jikei University Daisan Hospital

<sup>2</sup>Department of Surgery, The Jikei University School of Medicine

### ABSTRACT

**Purpose :** The purpose of this study was to evaluate measures to prevent recurrence after the tension-free repair (TFR) of inguinal hernias and optimal repair techniques for recurrent hernias.

**Methods :** Thirty-two patients with recurrent inguinal hernias after various types of TFR were reviewed to assess patterns of recurrence. Most recurrences were repaired with the Millikan modified mesh-plug method.

**Results :** The mean interval from repair to recurrence was 25.1 months. The most frequent recurrence pattern after plug-and-patch repairs and after Lichtenstein repairs (onlay repairs) was suprapubic recurrence due to insufficient overlap at the pubic tubercle (57% and 70%, respectively). With other repair methods, the recurrence pattern was variable ; however, indirect recurrences tend to occur after underlay repairs. In female patients, femoral recurrence was more frequent. Six cases of recurrence (19%) were suspected to have been missed hernias. The mean postoperative follow-up period in cases of recurrence was 47.8 months (range, 6 to 114 months) ; there were no major complications, but there was 1 case of second recurrence (3.1%).

**Conclusion :** To prevent recurrence after TFR, the high rate of missed hernias should be addressed. With onlay repair, sufficient suprapubic coverage is important. For female patients, preperitoneal repair is desirable. Millikan repair seems effective for recurrent hernia.

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**Key words :** Recurrent hernia, tension-free repair, Millikan modified mesh-plug repair, missed hernia, operative findings

### INTRODUCTION

Tension-free repair (TFR) of inguinal hernias has been reported to have a considerably lower rate of recurrence than does conventional suture repair, and in a recent meta-analysis, the recurrence rate after suture repair was 4.9%, that after open mesh repair was 1.6%, and that after laparoscopic repair was 2.7%<sup>1,2</sup>. However, because of the firm scar that forms after a mesh is used, the repair of recurrent

inguinal hernia after TFR is more difficult than that after suture repair, and the rate of third repair procedures for recurrence after a second repair procedure is more than twice as high as the rate of second repair procedures for recurrence after a primary operation<sup>3,4</sup>. Therefore, preventing recurrence after primary repair operations is an important issue. After Lichtenstein repair, the most commonly used technique in the world, 62% of recurrences are direct and 23% are suprapubic<sup>5</sup>. However, recurrence patterns after

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諏訪 勝仁, 羽生 健, 鈴木 俊亮, 中島紳太郎, 岡本 友好, 小村 伸朗, 矢永 勝彦

Mailing address : Katsuhito SUWA, Department of Surgery, The Jikei University Daisan Hospital, 4-11-1 Izumihoncho, Komae City, Tokyo 201-8601, Japan.

E-mail : katsuhito-s@jikei.ac.jp

other types of TFR are not well understood and require verification.

Another important issue with recurrent hernias is the selection of repair techniques. Although the European Hernia Society guidelines recommend laparoscopic repair for recurrence after open anterior repair, in which the repair is performed on a different layer<sup>6</sup>, a recent meta-analysis found no obvious advantage of laparoscopic repair over open repair for recurrences<sup>7</sup>. Laparoscopic repair for primary hernia repair has a steep learning curve and requires an above-adequate skill level for good results. The repair of recurrences is technically demanding and requires an even higher skill level. Moreover, even if recurrence is repaired with an anterior approach, scar tissue may limit to create the space for mesh placement, which is associated with a risk of injuring organs, such as the spermatic cord and urinary bladder. To repair recurrences, we most often use the Millikan modified mesh-plug technique<sup>8</sup> via an anterior approach, without damaging the scar tissues produced by the mesh placed in the previous operation.

In the present study, we evaluated the causes of recurrence associated with each technique used for the initial repair of inguinal hernias at our institution and reviewed the operative outcomes of repair techniques for recurrent inguinal hernias.

## PATIENTS AND METHODS

During a 10-year period from January 2003 through December 2012, 1,435 cases of inguinal hernia repair were performed at Daisan Hospital, The Jikei University School of Medicine. Of these cases, 32 cases (2.2%) of hernia recurrence after TFR were investigated through a review of medical records. Recurrence was diagnosed with both physical examinations (the presence of a bulge or expansile

cough impulse around the previous repair scar) and imaging examinations (ultrasonography or computed tomography). The standard perioperative hospital stay was 2 nights and 3 days, with patients discharged on postoperative day 1. Patients were required to visit our outpatient clinic for check-ups 1 week, 1 month, and 1 year after discharge. The final check for recurrence after the repair of a recurrent hernia was performed via postal questionnaire, which was returned by February 2013, when the results were finalized.

The patient characteristics, the side of recurrence, the interval until the diagnosis of a recurrence, and the number of recurrences are shown in Table 1. Possible causes of hernia recurrence after TFR were evaluated on the basis of operative findings, including hernia type and the condition of the mesh placed in the previous repair (plug-and-patch repair, Lichtenstein repair, Kugel repair, modified Kugel repair, Rives repair, Prolene<sup>®</sup> Hernia System repair [Ethicon, Inc., Sommerville, NJ, USA]); the Lichtenstein and plug-and-patch repairs were grouped together as onlay repairs, and the Kugel, modified Kugel, and Rives repairs were classified as underlay repairs. The recurrence patterns after these 2 types of repair were then compared. Furthermore, the recurrences were compared according to patient sex. Hernias with a short interval between the previous repair operation and recurrence and without sufficient preoperative or intraoperative evaluations of the whole affected groin area were defined as “missed hernias.” The operation time for repair of recurrent hernia, postoperative complications, and second recurrences were also reviewed.

### 1. Operative techniques (Table 2)

The anesthetic method used was regional or local anesthesia (to allow the patient to apply abdominal pressure during the operation) in all but 3 cases with incarceration, in which a general anesthesia was used. Before surgery,

Table 1. Patients background

Age, years (range)	66.5±12.3* (38-89)
Sex (Male : Female)	28 : 4
Location of lesions (Right : Left)	22 : 10
Period to diagnosis of recurrence, months (range)	25.1±31.0* (1 day-120 months)
Number of recurrences	
1	26
2	6

\*Mean±S.D.

Table 2. Operative techniques of recurrent hernias

Recurrent hernia type	Repair technique				
	Millikan modified mesh-plug (n=24)		Plug repair via femoral approach (n=5)	Lichtenstein (n=2)	Modified Kugel (n=1)
	Without onlay (n=21)	With onlay (n=3)			
Direct (n=17)	12*	3		1	1
Indirect (n=9)	8			1	
Femoral (n=5)			5		
Combined (n=1)	1				

\*Re-recurrence in one case

Table 3. Previous hernia type in relation to recurrent hernia type

Hernia type for which previous procedure was to repair**		Recurrent hernia type		
		Direct (n=12)	Indirect (n=6)	Femoral (n=3)
Direct	(n=10)	7 (70%)	2 (20%)*	1 (10%)*
Indirect	(n=8)	2 (25%)	4 (50%)	2 (25%)*
Femoral	(n=1)	1 (100%)		
Combined	(n=1)	1 (100%)		
Recurrent direct	(n=1)	1 (100%)		

\*Missed hernia, \*\*data available in 21 patients

the patient was asked to stand so that the surgeon could mark the bulge. An incision was made on the skin where the mark was located, and the operation was performed through an anterior approach. After the hernia sac was identified, dissection was performed from the surrounding tissue toward the hernia orifice. If necessary, the inguinal canal was opened to identify the hernia orifice. The technique used was, in most cases, a Millikan modified mesh-plug repair (n=24). An onlay patch was not used unless the hernia orifice was large and the inguinal canal could easily be opened with adhesiolysis. A Lichtenstein repair was performed in 2 cases in which a plug insertion space could not be obtained, and a modified Kugel repair was performed in 1 case in which dissection inside the inguinal canal and the preperitoneal space was easily performed. For all 5 cases of femoral hernia, mesh-plug repair via the femoral approach was performed. After mesh placement the patient was asked, when possible, to apply abdominal pressure by coughing or other methods to check for protrusion of the hernia sac.

2. Statistical analysis

Data were analyzed with Fisher’s exact test by means of Stata 11 software, version 11.1 (Stata Corp., College Sta-

tion, TX, USA).

RESULTS

In 21 of the 32 cases of hernia recurrence after TFR, information on the previous hernia type was obtained preoperatively (Table 3). For direct hernias (n=10), direct recurrence was the most common (70%), while other types of recurrence, namely indirect recurrence (20%) and femoral recurrence (10%), were presumed to be missed hernias. Among the cases in which the previous repair procedure was performed for an indirect hernia (n=8), recurrences were direct in 2 cases (25%), indirect in 4 cases (50%), and femoral in 2 cases (25%). The 2 femoral recurrences were suspected to represent missed hernias. The postoperative recurrences for cases of femoral hernia, combined hernia, and recurrent direct hernia were all direct recurrences.

The types of recurrence for different procedures are shown in Table 4. When onlay repairs (n=24) and underlay repairs (n=6) were compared (Table 5), the recurrence patterns were significantly different (P=0.045). After onlay repairs, recurrent hernias tend to be the direct type, while after underlay repairs, the recurrences tend to be the

Table 4. Recurrence after tension-free repair

Previous repair	Recurrent hernia type			
	Direct (n=17)	Indirect (n=9)	Femoral (n=5)	Combined (n=1)
Plug-and-patch (n=14)	8 (57%)	2 (14%)	4 (29%)	
Lichtenstein (n=10)	7 (70%)	3 (30%)		
Kugel repair (n=2)		2 (100%)		
Modified Kugel (n=2)	1 (50%)	1 (50%)		
Rives (n=2)			1 (50%)	1 (50%) (direct+indirect)
Prolene® Hernia System repair (n=2)	1 (50%)	1 (50%)		

Table 5. Comparison of recurrent types between onlay and underlay group

Repair technique	Recurrent hernia type			
	Indirect	Direct	Femoral	Combined
Onlay group (n=24)	5 (21%)	15 (63%)	4 (17%)	
Underlay group (n=6)	3 (50%)	1 (17%)	1 (17%)	1 (17%)

$P=0.045$

Table 6. Comparison of recurrence by gender

Sex	Recurrent hernia type			
	Direct	Indirect	Femoral	Combined
Male (n=28)	16 (57%)	9 (32%)	2 (7%)	1 (4%)
Female (n=4)	1 (25%)		3 (75%)	

$P=0.021$

indirect type. As to sex difference (Table 6), the recurrence patterns were statistically different ( $P=0.021$ ). The femoral recurrences tend to occur among women. For each type of procedure, the postoperative interval until recurrence and the cause of recurrence are described below.

### 1. Plug-and-patch repair (Table 7)

All 8 cases of direct recurrence were suprapubic hernias, which might have been caused by insufficient coverage at the pubic tubercle. Four cases were recurrences of femoral hernias, of which 3 cases (75%) had a short postoperative time before the diagnosis of recurrence, with a mean of 5 months (range, 3 to 9 months). The records of previous operations indicate that the preperitoneal space had not been explored in these cases, which strongly suggests missed hernias. The single case of a missed femoral hernia involved incarceration. Two cases of indirect recurrence were after indirect hernia repair; in both cases, recurrence was between the spermatic cord and the plug,

which had shrunk or had been dislodged from the internal inguinal ring.

### 2. Lichtenstein repair (Table 8)

Recurrences in 7 cases (70%) appeared to be of the direct suprapubic type caused by insufficient coverage of the pubis. Of the 3 cases of indirect recurrence, 1 case showed protrusion from a mesh slit, and the other 2 cases presented as recurrence with incarceration on postoperative days 1 and 14 and were likely missed hernias.

### 3. Kugel repair

Recurrence in 2 cases was diagnosed at 17 months and at 96 months. The recurrence in both cases was indirect and caused by mesh shrinkage and dislocation in the preperitoneal space.

### 4. Modified Kugel repair

Recurrence was diagnosed in 2 cases. Suprapubic di-

Table 7. Recurrence after plug-and-patch repair ( $n=14$ )

Interval between repair and recurrence, months (range)	23.9 (1-84 months)
Cause of recurrence	
Insufficient overlap at pubic tubercle	8 (57%)
Missed femoral hernia	3 (21%)*
Plug dislocation or shrinkage and inadequate onlay-patch placement	2 (14%)
Femoral hernia	1 (7%)

\* incarcerated hernia in 1 case

Table 8. Recurrence after Lichtenstein repair ( $n=10$ )

Interval between repair and recurrence, months (range)	29.0 (1 day to 84 months)
Cause of recurrence	
Insufficient overlap at pubic tubercle	7 (70%)
Missed indirect hernia	2* (20%)
Indirect recurrence through mesh slit	1 (10%)

\* incarcerated hernia in 1 case

Table 9. Missed hernias

Age, years (range)	70.3 (56-77)
Sex (male : female)	3 : 3
Period to diagnose recurrence, months (range)	2.8 (1 day-9 months)
Previous hernia type (direct : indirect)	3 : 2*
Recurrent hernia type (femoral : indirect : direct)	3 : 2 : 1
Previous operation (Plug and patch : Lichtenstein : Prolene Hernia System)	3 : 2 : 1
Maneuvers during previous operation	
Exploration of preperitoneal space (Performed : Not performed)	1 : 5
Checking of obliterated part of processus vaginalis peritonei within the internal inguinal ring (Performed : Not performed)	1 : 5
Patient-induced abdominal pressuring (Performed : Not performed)	0 : 6
Type of anesthesia (epidural : spinal : general)	3 : 2 : 1

\*unknown in 1 case

rect recurrence diagnosed at 3 months was caused by mesh dislocation, and indirect recurrence diagnosed at 7 months arose between the mesh and the internal oblique muscle in the lateral triangle.

##### 5. *Rives repair*

Recurrence was diagnosed in 2 cases. A combined indirect and direct recurrence was diagnosed at 12 months, and an incarcerated femoral recurrence was diagnosed at 120 months. In both cases, the recurrence was attributed to mesh shrinkage.

##### 6. *Prolene® Hernia System repair*

Recurrence occurred in 2 cases. The recurrence at 6

months was an incarcerated indirect recurrence caused by underlay patch shrinkage and insufficient closure of the onlay patch slit, and the recurrence at 1 month was a missed direct hernia.

Six cases of recurrence in (19%) were presumed to be missed hernias (Table 9). The patients were 3 men and 3 women with a mean age of 70.3 years. The mean postoperative time until recurrence was 2.8 months, with 1 case presenting with a bulge while the patient was standing on the day after repair. The type of hernia repaired in the previous operation was known in 5 of 6 cases : direct in 3 cases and indirect in 2 cases. The recurrence was femoral in 3 cases, indirect in 2 cases, and direct in 1 case. The missed hernias in the female patients were femoral. The

Table 10. Operative outcome

Operation time, minutes (range)	Overall	(n=32)	64.7±30.5*	(30-150)
<i>Millikan modified</i>	<i>Without onlay</i>	(n=21)	61.2±26.9*	(30-113)
<i>mesh-plug repair</i>	<i>With onlay</i>	(n=3)	72.5±34.9	(54-100)
<i>Femoral plug repair</i>		(n=5)	54.8±24.9	(30-105)
<i>Lichtenstein repair</i>		(n=2)	95.0±35.0	(60-130)
<i>Modified Kugel repair</i>		(n=1)	150	
Operative complication				
Intraoperative spermatic cord injury			1	
Recurrence			1†	

\* mean ± s.d.

† after Millikan plug repair without onlay patch

type of repair that had been used was plug-and-patch repair in 3 cases, Lichtenstein repair in 2 cases, and Prolene® Hernia system repair in 1 case. Review of the operative records of these cases indicated that the obliterated region of the processus vaginalis peritonei within the internal inguinal ring was identified during direct inguinal hernia repair in only 1 case, and the preperitoneal space was explored in only 1 case. In all 6 cases, the patients were not asked to cough or to apply abdominal pressure during the repair procedure.

The results of recurrent hernia repair are shown in Table 10. The mean operation time was 64.7 minutes. In Millikan plug repair, procedures without an onlay patch tended to take less time. As an operation-related complication, spermatic cord injury occurred in 1 patient in whom the opening of the inguinal canal was attempted during Millikan plug repair for a direct suprapubic hernia that recurred after Lichtenstein repair. Recurrence after Millikan plug repair without an onlay patch for a suprapubic recurrence occurred in only 1 case 19 months after the repair operation for the initial recurrence.

## DISCUSSION

Operations for recurrence after TFR are generally more difficult than those for recurrence after conventional suture repair. For this reason, surgeons performing TFR should be familiar with the pitfalls of each technique so that recurrence is not induced. We reviewed cases of post-TFR recurrence from our 10 years of experience performing inguinal hernia repairs and examined patterns of recurrence. An important issue in post-TFR recurrence is preventing missed hernias. A missed hernia, otherwise

referred to as an overlooked hernia, is defined as a “hernia that was present but unrecognized at the time of a primary hernia repair and subsequently appears as a new hernia,” and is most likely to occur after repair of a direct hernia<sup>9</sup>. To prevent “missed hernias,” sufficient palpation of the internal inguinal ring and femoral ring should be performed during the operation. A concomitant inguinal hernia reportedly exists in 14% of cases of hernia<sup>10</sup> and is the most common cause of missed hernias. According to our data, 19% of recurrent hernias are considered to be missed hernias, half of which were femoral hernias in female patients. As the European Hernia Society guidelines indicate, in female patients, the possible existence of a simultaneous femoral hernia with an inguinal hernia should always be considered, and preperitoneal repair should be performed to simultaneously cover the myopectineal orifice of Fruchaud (MPO) if possible<sup>6</sup>. Missed hernias in male patients occurred in association with both indirect and direct hernias; in addition to exploration by palpation, as noted previously, the application of abdominal pressure by the patient should be regarded and performed as a standard procedure in hernia repair. To rule out indirect inguinal hernias, which are often overlooked during the repair of direct inguinal hernias, we always confirm the absence of elongation of the obliterated region of the processus vaginalis peritonei.

A study examining cases in the Danish Hernia database and the Swedish Hernia database has described post-Lichtenstein recurrence patterns in detail<sup>5</sup>. This report found that the recurrent hernias were direct in 62% of cases, indirect in 17%, femoral in 13%, and unclassifiable in 8%. Suggested possible reasons for recurrence were insufficient suprapubic coverage of the onlay mesh and inade-

quate mesh fixation for direct recurrences and missed hernias for indirect recurrences. Amid and Lichtenstein themselves also reported, on the basis of their vast experience with this technique, that the small number of recurrences (0.1%) were all suprapubic recurrences<sup>11</sup>. Amid et al. used an 8×16-cm mesh and fixed an onlay patch covering 1 to 1.5 cm of the pubic tubercle<sup>9</sup>, but owing to the recent improvement in recurrence patterns for post-Lichtenstein repair, an overlap of 2 cm on the pubis is now recommended<sup>12</sup>.

The benefits and the low associated recurrence rate (0.2% to 1.4%) of plug-and-patch repair, which are considered to be equivalent to those of Lichtenstein repair in the field of open mesh repair, are also widely known<sup>13-17</sup>, but the recurrence patterns have yet to be reported in detail. In our cases of recurrence after post-plug-and-patch repair, the plugs had shrunk or become dislodged. Indirect recurrence was a protrusion from the onlay patch slit, and direct recurrence was caused by a folding back of the onlay mesh or inadequate coverage of the pubic tubercle because of shrinkage. The concept of plug-and-patch repair is to repair the hernia orifice with a plug; because the onlay is only placed as a double guarantee, no fixation is considered necessary. However, as shown in Table 4, even when cases of missed hernia are excluded, direct recurrence can be observed after primary repair of indirect hernias. This fact suggests that dissection inside the inguinal canal induces herniation at a different site. Therefore, the onlay patch should be placed securely, even in plug-and-patch repair, as in Lichtenstein repair. Furthermore, in terms of the double guarantee of underlay patch and onlay patch, the same applies to repair with the Prolene® Hernia System. The indirect hernia was a common recurrent hernia after underlay repair. This result closely resembles reports on transinguinal preperitoneal repair (TIPP) by Pélissier<sup>18</sup> and Pélissier et al<sup>19</sup>. It is still possible that missed hernia occurred in TIPP, but because hernias can recur long after the initial repair procedure, surgeons must perform adequate dissection of the preperitoneal space, parietalization, and secure placement of the patch without deformity<sup>20</sup>.

The Rives repair, unlike the Kugel and modified Kugel techniques, requires sufficient fixation. Because recurrence patterns for mesh repair have been reported, Rives repair should be performed only by surgeons skilled in this particular procedure. As of today, there is no standard op-

erative procedure for recurrent hernia repair. If hernia recurs after conventional suture repair, careful adhesiolysis allows a wider selection of techniques. However, in the case of recurrence after TFR, the mesh placement layer may include a stiff scar from the previous operation, and creating space in this layer may cause complications, such as organ injury<sup>21</sup>. The effectiveness of preperitoneal repair for recurrent hernia was documented by Nyhus as far back as 1989<sup>22</sup>, and the European Hernia Society guidelines for recurrence after open mesh repair recommend a laparoscopic procedure in which different layers are dissected<sup>6</sup>. The rate of second recurrence after repair of a recurrent inguinal hernia is reported to be approximately 9%<sup>3</sup>. Although the rate of second recurrence can be reduced to 2% by skilled surgeons<sup>23,24</sup>, a recent meta-analysis did not demonstrate an advantage of laparoscopic repair over open mesh repair<sup>7</sup>. In fact, laparoscopic repair has several disadvantages, such as its technically demanding nature and the need for general anesthesia. In cases of recurrence after TFR, the firm scar tissues surrounding the hernia orifice limits the space for onlay patch placement, and attempts to create space may result in spermatic cord damage and subsequent orchitis or testicular atrophy.

Millikan modified mesh-plug hernioplasty is a procedure in which only the inner petals of the mesh plug are sutured and fixed to the hernia orifice, whereas the outer petals are spread flat in the preperitoneal space. This technique has advantages similar to those of other preperitoneal repair techniques that utilize Pascal's principle and have a reduced need for an onlay patch, compared with the original mesh-plug repair<sup>8</sup>. For this reason, we consider Millikan repair to be a suitable procedure for hernias recurring after TFR. The mean operative time with the Millikan repair without an onlay patch in our series was 61.2 minutes. Complications occurred in only 1 case in which the spermatic cord was injured when the inguinal canal was opened to secure space to place an onlay patch. Hernia recurred a second time in only 1 case, accounting for 5% of the total recurrences treated with a Millikan plug repair without an onlay patch; however, if all 32 cases are considered, the recurrence rate was only 3%. Therefore, in Millikan plug repair procedures, the use of an onlay patch is not required to reduce the rate of complications or to shorten the operation time. The recurrence rate was also considered to be acceptable.

### CONCLUSION

After the TFR of an inguinal hernia, direct recurrence is common after plug-and-patch and Lichtenstein repairs using an onlay patch, whereas indirect recurrences is common after Kugel, modified Kugel, and Rives repairs using an underlay patch. Female patients have a higher rate of femoral recurrence than do male patients, and a preperitoneal repair that enables the total repair of the MPO is desirable in female patients. Suspected missed hernias account for 19% of recurrent hernias and emphasize the importance of exploration before and during the operation and careful consideration of cautionary points of specific procedures to prevent recurrence.

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