

## Laparoscopic Repair of a Ventral and Incisional Hernia (LRVIH) via Endoscopic Dome Surgery by Sitting Position (EDSS)

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**Abstract :** A ventral and incisional hernia is one of the serious complications. Recently, underlay mesh repair using a laparoscope is frequently performed. As a result, a new surgical position for LRVIH has thus been devised. **Methods :** The subjects are comprised of 15 patients with a primary or recurrent hernia who underwent LRVIH during the period of 2006 to 2008. In EDSS, the surgeon, the assistant and the laparoscope operator sit on chairs, and the surgical table and the monitor are placed so as to obtain good hand-eye coordination. **Results :** The mean Body Mass Index was 25.2. Bi-layered expanded polytetrafluoroethylene (ePTFE, Bard®) mesh was used in all of the 15 subjects. The largest size of the hernia orifice was 282.7 cm<sup>2</sup> and average was 51.8 cm<sup>2</sup>. No recurrence of hernia was observed, but seroma occurred in 4 patients. Most patients complained of an abdominal pain after the surgery and they are administered of some analgesics for at least 5 days in 10 subjects (66.7%) and oral analgesics (NSAIDs). In LRVIH, the most procedures should be done at the ceiling of the pneumonized abdominal cavity. Thus EDSS is suitable to keep hand-eye coordination, which is important in endoscopic surgery. When sitting on a chair, the surgeon could easily handle surgical forceps and scissors. This surgical position seems to be highly ergonomic and relieve our mental and physical fatigue. **Conclusions :** The outcome of surgery for LRVIH is good, and EDSS can be performed both comfortably and safely, while inducing less fatigue for the physicians.

**Key words :** Incisional Hernia, Laparoscopic Repair, Hand-Eye Coordination

### Introduction

In open surgery for a ventral and incisional hernia, an overlay mesh repair is often carried out. In such case, polypropylene mesh is usually placed on the fascia in order to cover widely the hernia orifice and to secure the fascia with sutures. However, it frequently causes recurrence due to the ventral over pressure or the insufficient sutures. Thus a new method of underlay mesh repair is performed, in which expanded polytetrafluoroethylene (ePTFE, Bard®) mesh is secured to the peritoneal membrane on the visceral side and the hernia orifice is directly closed from the

inside.<sup>1)4)</sup> However, this requires a large incisional wound in the ventral wall that is equal to or larger than the previous surgical wound, causing severe damage to the ventral wall.

In recent years, the underlay mesh repair becomes less invasive and rare recurrence when performed under laparoscopic surgery by inserting this ePTFE mesh into the ventral cavity and securing it to the ventral wall from the visceral side.<sup>1)4)</sup> When the ventral wall is quaquaversally dilated by creating a pneumoperitoneum during endoscopic surgery, our operation staffs (the surgeon, the assistant and the endoscope operator) perform the procedure in sitting on chair. The sitting position operation is ergonomically superior

to obtain better vision and lower physical fatigue. We refer to this surgical method as Endoscopic Dome Surgery by Sitting position (EDSS) in our hospital. Here, we describe the surgical performance regarding the laparoscopic repair of the incisional hernia, mainly as a surgical technique that is performed at our department and the post-operative course.

## Methods

### Patient selection

The study was conducted with 15 subjects who underwent LRVIH during the period of 2006 to 2008 (Table 1).

#### 1. Preoperative examination

The previous surgical findings of a ventral and incisional hernia are sufficiently recorded. Moreo-

ver, the size of the defective part of the ventral wall and the hernia content are assessed in a contrast-enhanced computed tomography (CT) examination. When the adhesion of the intestinal tract is suspected within the hernia, radiological enteroanalysis is performed before the surgery in order to assess the condition of the adhesion. The condition of the adhesion is assessed using a water-soluble contrast agent. Furthermore, it is ascertained via an imaging test whether there is any adhesion of the intestinal tract at a site that is distant from the hernia orifice where the insertion of a first trocar is anticipated.

#### 2. Bowel preparation before surgery

Bowel preparation is performed for the intestinal tract before the surgery using Magnesium Citrate. With a dilated intestinal tract, a surgical field cannot be obtained for laparoscopic surgery,

Table 1. Patient Demographics (total n = 15)

Characteristics	Value (Mean $\pm$ SD)
Sex : M/F	4/11
Age, years	73.9 $\pm$ 6.5
ASA score	1.6 $\pm$ 0.65
BMI, kg/m <sup>2</sup>	25.2 $\pm$ 5.26
Previous Operation time	1.79 $\pm$ 0.7

SD = standard deviation ; ASA = American society of anesthesiologists, BMI = body mass index



Fig. 1. Endoscopic Dome Surgery by Sitting Position (EDSS)  
The surgeon sits on a chair and the surgical table is set relatively high so that the eyes of the surgeon, the surgical field, and the monitor align almost linearly, creating good hand-eye coordination.

causing difficulty for the surgical technique. Furthermore, if the intestinal tract is damaged when exfoliating the adhered intestinal tract, then the contaminated area within the ventral cavity will spread.

### 3. Operative technique

#### A. Body position and placement of the video monitor

The surgeon stands on the right or left side of the patient, depending on the location of the hernia, and a trocar is inserted sufficiently distant from the hernia orifice, so that when the hernia is located on the right side, the surgeon stands on the left side of the patient, or when the hernia is located on the left side, the surgeon stands on the right side of the patient. The arm of the patient on the side in which the surgeon stands is wrapped around the surgical table, and the legs are spread so that they will not disturb the laparoscope operation. A video monitor is placed on the side opposite from the surgeon.

The surgeon, the assistant and the laparoscope operator perform the surgical procedure while being seated on chairs. In endoscopic sitting dome surgery, the surgeon sits on a chair and the surgical table is set relatively high so that the eyes of the surgeon, the surgical field, and the monitor align almost linearly, creating good hand-eye coordination, which is important in endoscopic surgery, and the surgical procedure using forceps becomes easier in exfoliating the adhesion of the ventral and incisional hernia or ventral wall. Moreover, it is ergonomically suitable and induces less mental and physical fatigue in the physician ( Fig. 1 ).

#### B. Position of the port

In general, one 12-mm trocar for the camera and two 5-mm trocars for manipulation are used. When a hernia is located on the median of the upper abdomen, the first trocar is inserted in the lower left abdomen, followed by a trocar for manipulation, considering the hand-eye coordination, but at this time, the trocar is inserted so as to penetrate the ventral wall so that the surgical procedure using forceps will be as easy as possible, and it is necessary to be sufficiently aware of the space

between the trocars. Moreover, when adhesion of the intestinal tract or omentum with the hernia orifice or the sac is frequently exfoliated and the trocar is placed at the position of the iliac crest, the surgical procedure using forceps is often disturbed, so much attention should be paid.

#### C. Types of scopes

Rigid scopes are used when performing the surgery, but 10- or 5-mm rigid scopes with 30- and 45-degree squint scopes are used. When securing the ePTFE mesh fixation, a visual field is made in which the hernia orifice faces the ceiling, so a 45-degree angle scope is superior. Furthermore, with the 45-degree angle, the visual field behind the adhered object of the ventral wall can be obtained, so it is suitable for observing the extent of adhesion to the hernia orifice. The reason for using a 5-mm scope is that the scope can be inserted through any type of a trocar, and hand-eye coordination can be obtained for a visual field of suitable angles, so it is very effective. The posterior sides of the adhesion and the intestinal tract can also be observed, and inadvertent organ damage can be prevented.

#### D. Forceps

In observing the hernia orifice, organs within the ventral cavity are frequently grasped, so laparoscopic intestinal forceps are essentially used and operated with care. Organs that adhere to the hernia orifice include organs that are free within the ventral cavity such as the small intestine, omentum, large intestine, ovaries, etc. In exfoliating the small intestine, direct grasping of the intestinal tract should be avoided as much as possible, and sharp dissection should be performed using laparoscopic scissor forceps. It is necessary to make a cut naturally and extraperitoneally at a site in which the adhesion of the intestinal tract is severe. The damage to the ventral wall may cause re-adhesion of the organ, so it should be avoided. Furthermore, if the omentum is separated incompletely, hemorrhage may be caused, so it should be performed as close as possible to the ventral wall. When the separation is completed, the hemorrhage should be securely arrested using an ultrasonic activated device ( USAD ) or the like.

#### E. Exfoliation around a hernia orifice

The following are points for avoiding damage to the intestinal tract : a basic exfoliating procedure is performed in accordance with a laparotomy ; and when the intestinal tract is adhered to the hernia orifice or the hernia sac, sharp dissection is performed with intestinal forceps held in the left hand and laparoscopic scissor forceps held in the right hand, and at this time, the dissection is performed after the posterior surface of the adhesion is sufficiently observed. In endoscopic sitting dome surgery, the organ that has adhered to the hernia orifice due to the creation of a pneumoperitoneum is raised to the ventral wall, and it is possible to perform exfoliation by applying light counter traction. Note that a monopolar electric knife causes delayed damage to the intestinal tract( especially large intestine ) due to the burning effect, so exfoliation is performed using a USAD with the temperature as low as possible or bipolar.

However, when it is determined that it would be difficult to exfoliate using a laparoscope because of severe adhesion, it is important to switch to a laparotomy without hesitation.

#### F. Compression from the body surface

If the hernia sac is large, applying compression to the hernia sac from the body surface may facilitate the exfoliating procedure. During the exfoliation of an area of adhesion in the intestinal tract in the left hand can be used as a hand-assisted technique, and a gentle procedure can be performed. As a result of using this technique, the compression is more effective for the treatment of a larger hernia orifice.

#### G. Selection of a reparative material

Current options for the reparative materials for the ventral wall repair include 3 types : Composix® (Bard®), Composix Kugel® (Bard®), and Gore-Tex®(Gore & Associate® : micro mesh) Composix Kugel® has a ring frame and is rigid, and once it is inserted into a ventral cavity, it easily expands, so it is easy to secure. Composix® does not have a frame and is more rigid than Gore-Tex®, and it is possible to adjust the size by cutting with scissors within the limited range, and it is believed that it is most commonly used. Thus a new method of un-

delay Composix® mesh repair is performed, in which expanded polytetrafluoroethylene (ePTFE) mesh is secured to the peritoneal membrane on the visceral side and the hernia orifice is directly closed from the inside.

As for mesh size, the size of the hernia is measured before the creation of a pneumoperitoneum. The size of the hernia orifice becomes larger after the pneumoperitoneum has been formed because of the tension that is applied to the ventral wall, so the material is used after being trimmed to a size that is approximately 3 cm smaller than the hernia orifice before the surgery. In order to avoid contaminating the mesh, the direct application of the mesh to the ventral wall is avoided as much as possible, and after the hernia orifice is marked using a cutaneous pen, a paper pattern is placed and the paper pattern is applied to the mesh in order to prevent contamination.

#### H. Insertion of repair material into the ventral cavity

As for the repair material, ePTFE is internally rolled up and inserted through the 12-mm trocar. When the repair material is small, there is no problem, but if the larger repair material is necessary, a 15-mm trocar is initially selected, the trocar is once removed, and the repair material is directly inserted into the ventral cavity. Almost any size of repair materials can be inserted with this procedure.

#### I. Securing repair material to the ventral wall

First, 3 spots are marked on the repair material using nonabsorbent monofilament yarns (3-0) by securing 1 of these to the upper end of the repair material and the other 2 to the base so as to create an isosceles triangle. Thereafter, the repair material is rolled up and inserted through the trocar. These 3 pieces of yarn are first pulled toward the ventral wall using ENDO-CLOSE™ (COVIDIEN, Norwalk, CT), and an approximately 2-mm incision is made on the body surface, the yarns are each brought out using the ENDO-CLOSE™, and suturing is subcutaneously performed in order to secure the repair material to all layers of the ventral wall. After the repair material has been secured to the ventral wall at the 3 spots, a laparo-

Table 2. Outcomes of Surgery

Characteristics	Value ( Mean $\pm$ SD )
Defect size, cm <sup>2</sup>	51.8 $\pm$ 75.4
Operating time, min	157.3 $\pm$ 60.6
Seroma ( and % )	4 ( 26.7 )
Period of required pain killer, days	5.9 $\pm$ 3.3
Previous Operation time	1.79 $\pm$ 0.7
Length of hospitalization, days	13.9 $\pm$ 7.7

SD = standard deviation

scope is inserted on the back side of the repair material. Subsequently, a monofilament yarn is inserted through a 23G needle and a 2-mm skin incision is similarly made in order to have the needle penetrate, through the same site, the repair material from the ventral wall. After penetration, the monofilament yarn is grasped using straight grasping forceps in order to remove the needle, and the ENDO-CLOSE™ is inserted, slightly laterally from the incised part, through to the outside of the repair material in order to guide the monofilament yarn to the ventral wall using the ENDO-CLOSE™ and to catch it up. The repair material is circumferentially fixed with knots at approximately 3-cm intervals by repeating this procedure. The repair material is secured evenly so that it will not be "creased." Hernia patients tend to have a large amount of subcutaneous fat, and monofilament yarns are easily embedded under the skin by being subcutaneously tied. Moreover, in the hernia of the lower abdomen, when the hernia orifice extends close to the bladder, securing in all of the layers using a monofilament yarn may penetrate the bladder, so securing is performed from the posterior side using a laparoscopic tucker. Currently, 2 types of tuckers are available from 2 companies in Japan: Pro-tuck, titanium coil tuckers, manufactured by Tyco Healthcare (COVIDIEN, Norwalk, CT) and stainless-steel coronoid tuckers by Johnson & Johnson.

#### 4. Postoperative management

No drain is inserted. If the hernia sac is large, light compression is applied for 24 hours, but there is no particular standard. A meal is taken on the following day, and when the pain subsides, the patient is discharged.

## Results

Among the 15 subjects, 4 subjects were male and 11 subjects were female. The average age was 74 years old (range of 60–88 years old). The average Body Mass Index (BMI) was 25.2 (range of 16–30). The average frequency of laparotomy before the present surgery was 1.8 times (range of 1–3), and a composite mesh was used in all of the 15 subjects. The hernia content included the omentum, small intestine, and large intestine. The average size of the hernia orifice was 51.8 cm<sup>2</sup>. The largest size was 282.7 cm<sup>2</sup>.

The average duration of surgery was 157 min. (range of 55–305 min.) The average hospital stay was 13.8 days (range of 6–33). The average ASA score was 1.6. The subjects with a score of 2 or higher accounted for 54%. The subjects who had heart failure after the surgery and who required treatment due to schizophrenia had more days of hospitalization. No recurrence of a hernia was observed in any of the subjects. The incidence rate of seroma after the surgery was 26.7%, which was observed in 4 subjects. As for pain, an analgesic was used for at least 5 days in 10 subjects (66.7%), and strong pain was observed, so an oral analgesic (NSAIDs) was used (Table 2).

## Discussion

A ventral and incisional hernia is conventionally regarded as being frequently found in obese patients, and the statistics at our hospital also showed that the average BMI was a slightly high value of 25.2. According to reports based on medical literature, the degree of obesity is a BMI of at least 30–35 kg/m<sup>2</sup> in many of the literary documents, and compared to abdominal surgery,

LRVIH in severe obesity shows no difference in the frequency of complications, the recurrence rate, or the mortality rate.<sup>1)~5)</sup>

Surgeons ordinarily perform laparoscopic surgery in the standing position. However, the ventral wall of the abdomen is seen only on the upper half of a monitor view during the laparoscopic repair of ventral and incisional hernias. The standing position of surgeons is therefore not comfortable in regard to ergonomic conditions from the surgeon's standpoint. The sitting position therefore seems to be ergonomically superior to the standing position for surgeons to maintain good hand-eye coordination.

Moreover, in our the endoscopic dome surgery in the sitting position (EDSS), hand-eye coordination, which is important in endoscopic surgery, improves by sitting in chair, thus resulting in the easier handling of forceps in exfoliating the adhesion of a ventral and incisional hernia and a ventral wall. In laparoscopic surgery, the eyes of the surgeon, the surgical field, and the monitor must all be placed in a straight line. Furthermore, when the surgeon's position is ergonomically appropriate, the both mental and physical stress decrease, thus making it possible to complete the operation safely and in a shorter time. This sitting position surgery is also applied to laparoscopic synechiotomy and similar treatment, and therefore would like to continue to study more cases.

The typical postoperative complication is the accumulation of serous fluid, and if an elevation is observed in the ventral wall after surgery, a diagnosis is easily made via a CT examination. It is said that the accumulation of serous fluid is observed between the ventral wall and the mesh after surgery in approximately 3% to 78% of all patients. The accumulation of serous fluid was also observed in 26.7% of the subjects at our department. It is reported that accumulation begins in approximately 3 weeks after surgery, and it naturally becomes milder within approximately 2 months. Treatment such as a puncture is not necessary, and it becomes milder.<sup>6)~8)</sup>

Another frequent complication is abdominal pain. The laparoscopic repair of a hernia is believed to be less invasive than a laparotomy and

rarely causes pain, but strong pain that does not subside with an analgesic may occasionally arise. It is believed that this occurs because of the involvement of nerves in the ventral wall, but the cause is unknown at present. The pain becomes milder with the epidural administration of continuous anesthesia, and we divert an epidural insertion for anesthesia. This pain arises during the early postoperative period and continues for approximately 1 week. The administration of an analgesic for at least 5 days was also required for 66.7% of the subjects in our department. This pain is specific to laparoscopic surgery, and it is believed that sufficient informed consent will be necessary before surgery.<sup>9)~11)</sup>

In addition, graft infection is also a complication that frequently occurs. The repair materials that are used in the repair of a hernia show differences in the frequency of contamination, depending on the type. A difference in the ratio of graft infection depending on the site of insertion is also reported, such as under the skin and within the ventral cavity. Within our experience, ePTFE sheet was used in all of the subjects, but no infection has been observed until the present time.<sup>12)~13)</sup>

The laparoscopic repair of a ventral and incisional hernia involves the problem of causing pain immediately after surgery, as well as the problems of the reparative materials and infection, the problem of recurrence, and problems of requiring an additional laparotomy, but it is believed that the frequency of ventral and incisional hernia will also increase in Japan due to the increase in the overweight population. LRVIH, which is less invasive than a laparotomy procedure, must be a standard at the present when once the development of reparative materials is advanced. Overseas, RCTs have already been conducted, but no large-scale randomized trial has not been conducted in Japan.<sup>14)~18)</sup>

Overall, our results are in line those of other series. As a result, we believe that endoscopic dome surgery in the sitting position (EDSS) for laparoscopic repair of ventral and incisional hernia is a feasible, safe, and effective alternative to open surgery, particularly when performed by highly experienced surgeons.



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