

Which should be the gold standard laparoscopic technique for handling Spigelian hernias?

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Abstract

Background The advantages and disadvantages of both extraperitoneal and intra-abdominal laparoscopic Spigelian hernia repair are still being discussed. To our knowledge, no study has compared both techniques in terms of safety, feasibility, and cost-effectiveness.

Method Prospective data were collected to compare the results of the extraperitoneal approach with the intra-abdominal approach in laparoscopic Spigelian hernia repair, between 2000 and 2012 ($n = 16$). Diagnosis was confirmed preoperatively by ultrasonography and/or tomography.

Results Spigelian hernias occur mostly in women (69 %), on the left side (56 %) and at a median age of 62 (range: 38–83). In our study, the extraperitoneal technique was performed in seven patients, while the intra-abdominal approach was indicated in nine. No complications, readmissions, or recurrences were detected in either during a mean follow-up of 48 months (range: 18 months–9 years). The statistical study showed that there was no difference in either morbidity or the recurrence rate between a totally extraperitoneal (TEP) and an intraperitoneal onlay mesh (IPOM) repair. The mean duration of an IPOM repair was, though, shorter than that of a TEP repair (30 vs. 48 min, $P = 0.06$). The combined fixation technique (tacks + glue)

did not modify the results but did reduce the costs, as shown in the cost-effectiveness study where the intra-abdominal approach was cheaper (1260 vs. 2200 euros, $P < 0.001$).

Conclusion Laparoscopy seems to be a safe and feasible technique whichever the approach chosen, be it intra or extraperitoneal. Our experience shows that intra-abdominal laparoscopic Spigelian hernia repair should be recommended as the gold standard because of its technical and economic advantages. The IPOM procedure with a lightweight titanium-coated mesh fixed using a combined technique is a highly effective option for Spigelian hernia repair.

Keywords Spigelian hernia · Laparoscopic repair · Lightweight mesh · Synthetic tissue adhesive · Extraperitoneal repair · Intra-abdominal repair

The Spigelian hernia (SH) occurs in the semilunar aponeurosis, the area between the semilunar line and the lateral edge of the rectus abdominalis muscle. It is also known as the lateral ventral hernia, semilunar line hernia, interstitial, or conjoint tendon hernia. They represent between 0.1 and 2 % of all abdominal wall hernias and are more frequent in older people (40–70 year olds), especially in women, and are very occasionally bilateral. Almost half of the cases have another associated hernia. The defect is usually small, with rigid edges with an incarceration rate of 27 % [1–3].

It is often difficult to give an accurate preoperative diagnosis because of the lack of specific signs. A right and accurate anamnesis is needed to avoid late handling of the illness, which is in itself common as it often appears to be an intraparietal hernia. The surgeon can either operate via an open or laparoscopic approach, and the literature describes good results for both [2–4]. Laparoscopic repair can be

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divided into the three forms which have been developed for treating other abdominal wall hernias: Totally extraperitoneal (TEP), transabdominal (TAPP), and intra-abdominal (IPOM), but at present, there is a great deal of controversy about which should be the approach of choice [4–6].

We present our experience with laparoscopic SH repair. The purpose of this study is compare the results with two techniques: TEP and intra-abdominal laparoscopic approach, in terms of safety, feasibility, and cost-effectiveness.

Materials and methods

Patients

The study was planned as a prospective single-center trial to evaluate the advantages and disadvantages of different laparoscopic options in SH repair: TEP versus IPOM. Between January 2000 and December 2012, 16 consecutive patients underwent laparoscopic surgery for SH, of which seven were TEP and nine intra-abdominal. Diagnosis was established at a specialized abdominal wall unit by physical examination and radiological confirmation with ultrasound and computerized tomography. The inclusion criteria specified that patients should be older than 18 years, diagnosed with a SH, that there was no co-morbidity (American Society of Anesthesiologists, ASA score: ASA I–II), and consent was given for synthetic glue fixation. Exclusion criteria were that patients were younger than 18 years, with ASA score III–IV, patients who had a strangulated hernia, current malignant diseases, proven mental illness, or other circumstances that might compromise the patient's cooperation in addition to those who refused to give informed consent. All the patients were operated upon by the same surgeon. The laparoscopic technique was chosen according to the characteristics of the hernia: for those hernias which were low (infraumbilical), smaller than 3 cm or with easily reducible content the TEP option was chosen; for those hernias which were high, bilateral, larger than 3 cm or with incoercible intestinal content the intra-abdominal option was chosen. Data were collected prospectively in a database. All the patients were given detailed information on the operation and the clinical trial, and gave their informed consent. The Ethics Committee of the University hospital approved the trial, and all procedures were performed in accordance with good clinical practice guidelines.

Surgical technique

All operations were performed with the patient under general anesthesia using endotracheal intubation and controlled artificial ventilation.

(i) TEP laparoscopy: a 1.5-cm horizontal incision was performed infraumbilically. This incision was carried down to the anterior rectus sheath which was also incised. The rectus muscle was then retracted laterally before a dissector balloon was inserted behind the muscle and in front of the posterior rectus sheath. An end-viewing telescope was introduced into the device, while the balloon was being insufflated. Disruption of the aponeurotic fibers of the lateral edge of the rectus sheath at the level of the semicircular line of Douglas could be observed, and the peritoneal sac was reduced progressively. Two 5-mm trocars were placed, one just above the pubis and the other on the midline above it. A 15 × 15 cm polypropylene-coated titanium mesh (35 g/m², Tilene, Pfm, Germany) was used to overlap the defect widely (>5 cm) circumferentially, and fixed only with tacks as double crown technique (Secure-strap^R, Ethicon, USA) or with tacks in all four quadrants and 1 ml of *n*-hexyl- α -cyanoacrylate, combined fixation technique (IfabondTM, Fimed, France).

(ii) Intraperitoneal onlay mesh approach (IPOM): pneumoperitoneum was created using a Veress needle, and a 10-mm trocar for the telescope and two 5-mm trocars in a line along the left or right flank were inserted. The margins of the hernia defect were then determined and the contents reduced. The lightweight mesh was inserted through the 10-mm trocar and fixed with two crowns of tacks or one crown and 1 ml of synthetic glue (combined fixation).

Main outcome measurements

All patients were included in a follow-up program and were requested to attend a specific hernia consultation after 4 weeks, 6 months, and each year. The parameters evaluated were: clinical (age, sex, associated diseases, and prior abdominal surgery); intra-operative complications (bleeding, visceral lesions, rupture of the peritoneal sac because forced to work in worse conditions for leakage of pneumoperitoneum, and more skill required closing by laparoscopy); postoperative complications (seromas which persist more than 2 months or require aspiration, hematomas, and chronic pain were defined if it persists more than 3 months or need of analgesics, ileus if transit is not recovered in 24 h, urinary retention, neuralgias, infections, intestinal obstructions, rejections, and re-admissions) and recurrence rate (The recurrence was evaluated by physical exam and radiological imaging). The follow-up averaged 4 years (range 18 months–9 years) and was complete in 100 % of the patients.

Statistical analysis

Values were expressed as a mean \pm SD for continuous variables and as a number (%) for categorical variables.

Table 1 Characteristics of the patients diagnosed with Spigelian hernia and operated upon with laparoscopic hernioplasty

Demographics and clinical data			
	TEP (<i>n</i> = 7)	IPOM (<i>n</i> = 9)	<i>p</i> value
Age: years	64 ± 24	61 ± 25	0.4
Gender: male/female	2 (29)/5 (71)	3 (33)/6 (67)	–
BMI, kg/m ²	28 ± 7	29 ± 9	0.4
Previous abdominal surgery	1 (14)	4 (44)	0.23
Presentation			
Abdominal pain	2 (29)	2 (22)	0.6
Palpable mass	1 (14)	3 (33)	0.3
Pain and mass	4 (57)	4 (45)	0.5
Site			0.28
Left/Right	5 (71)/2 (29)	4 (45)/2 (22)	
Bilateral	0	3 (33)	
Another hernia associated	2 (29) 2IH	4 (44) 2IH + 2UH	0.45
Defect size: cm	3 ± 2	4 ± 3	0.23
Site: high/low	0/7	4 (44)/5 (56)	

Values were expressed as mean ± SD for continuous variables and number (%) for categorical variables

TEP total extraperitoneal patch, IPOM intraperitoneal onlay mesh approach, BMI body mass index, IH inguinal hernia, and UH umbilical hernia

Descriptive statistics for quantitative variables and frequencies with percentages were calculated. The normal distribution of the data was assured before performing statistical analysis. The data were compared using the ANOVA test for continuous variables expressed as a mean or the Fisher's exact test for quantitative variables expressed as a proportion. The *p* value was used as the criterion for significance at *P* < 0.05. Data were analyzed using SPSS software package for Windows (SPSS Inc., v18.0, Chicago, Illinois, USA). The cost for each operation was calculated by the hospital's Analytical Accounting Service, taking into account the necessary adjustments for inflation in both groups. The costs were calculated based on the called saving cost a patient (not opportunity cost). The analysis of clinical outcomes was done for a follow-up averaged 4 years.

Results

Eleven of the patients were female (69 %) and five were male, with a mean age of 62 years (range 38–83). Only seven patients were diagnosed correctly during the initial physical examination (44 %), and the other nine being diagnosed after performing ultrasound and/or tomography

Table 2 Postoperative and monitoring data for patients operated upon for Spigelian hernia with laparoscopic repair. Surgical parameters

	TEP (<i>n</i> = 7)	IPOM (<i>n</i> = 9)	<i>p</i> value
Duration of surgery (min)	48 ± 26	30 ± 12	0.06
Fixation technique			
Tacks	4	4	0.5
Tacks + glue	3	5	
Surgery room cost (Euros)	336 ± 182	210 ± 84	0.06
Hospital Stay (days)	1 ± 2	1 ± 3	0.5
Morbidity	0	0	1
Recurrences	0	0	1
Follow-up (years)	4.2 ± 2	3.8 ± 3.2	0.38
Training (<i>n</i> = 115)	2 (1.7)	103 (89.6)	<0.001

Values were expressed as mean ± SD for continuous variables and number (%) for categorical variables. Surgery room cost = 7 euros × duration of surgery. In training, *n* is the number of surgeons in our country; ten surgeons do not accept the laparoscopic approach (8 %)

TEP total extraperitoneal patch, IPOM intraperitoneal onlay mesh approach, Glue synthetic tissue adhesive (Ifabond), and Tacks reabsorbable (Secure-strap)

(56 %). Nine hernias were left-sided (56 %) and four right-sided (25 %), while a bilateral hernia was diagnosed in three cases (19 %). Six patients had another associated hernia (inguinal and umbilical) (38 %). Table 1 shows the patient's characteristics.

All patients were operated upon in the outpatient hospital: seven via the TEP approach, and nine using the intra-abdominal approach. No patients required conversion to open surgery, nor were any significant intra-operative complications recorded. The mean operative time was 36 min, with the range between 22 and 68 min. The lightweight mesh (35 g/m²) was fixed using the double crown of tacks in eight patients, or with tacks and synthetic glue (combined fixation technique) in eight (31 %). No early or late complications were detected during the follow-up averaged 4 years (hematomas, extraperitoneal or intra-abdominal bleeding, infections, intestinal obstructions, rejections, re-admissions, or recurrences), and there were no re-admissions related to SH repair (Table 2). None of the patients subsequently complained of chronic pain (>3 months).

The statistical study showed that there was no significant difference in morbidity or recurrence rate between TEP and IPOM repair (Table 2). The mean duration of IPOM was shorter than that of a TEP repair (30 vs. 48 min) but was not statistically significant (*P* = 0.06). The fixation technique was modified in 2006, moving from the traumatic mechanical double crown of tacks to a combined single crown of tacks and cyanoacrylate adhesive. No complications related to this have been observed: both forms having

Table 3 Cost analysis for the repair of Spigelian hernia cost analyse: TEP versus IPOM

	Intra-abdominal		Extraperitoneal		<i>P</i> value
Approach cost	Veress needle	11.66	Distension balloon trocar	420	
	10-mm trocar	66	Structural balloon trocar	110	
Instrumental ports					
5-mm trocar (×2)	5-mm trocar	36.63	Trocar corto punta anclaje	280	
Instrumental					
Pinzas (×2)	Pinza de agarre	80	Pinza corta	80	
Tijera	Tijera	60	Tijera	60	
Hernia repair					
Mesh (20 × 20 cm)	TiMesh	390	TiMesh	390	
Combined fixation	Secure-strap	400	Secure-strap	400	
	Ifabond	100	Ifabond	100	
Total cost (€)	1260.92		2200		<0.001

Cost are expressed in euros

(TiMesh, Pdf, Germany) (Secure-strap, Ethicon, USA); (Ifabond, Vitalitec, France)

the same rate of morbidity and recurrence, but by changing the fixation technique, we managed to reduce the final cost of the operation by 300 euros (Table 3).

The cost-effectiveness study shows statistically significant differences between the two techniques: the intra-abdominal approach was cheaper (1260 vs. 2200 euros, $P < 0.001$). The TEP approach was more expensive because of the specific material needed to prepare the surgical field, which cost (150.9 vs. 325.5) bearing in mind that the rest of the costs of the operation are similar (mesh, fixation, and instruments) (Table 3).

Discussion

Laparoscopic surgery has consolidated itself as the preferred option for treating abdominal wall hernias. The same techniques developed to repair inguinal hernias (TEP, TAPP, and IPOM) have also been used to treat SH, but the discussion about which is most suitable, the “gold standard,” is still ongoing. Our study shows that for this hernia, the results are good whichever technique is used.

Diagnosis problem

The SH differentiates itself from other abdominal wall hernias in that it is the most difficult to give a preoperative diagnosis for. Neither the clinical symptoms, nor physical examination, nor even on occasions ultrasonography provide a correct diagnosis. Maybe because of this, in recent years, more and more diagnoses made directly via laparoscopy have been published. This problem can be explained by the hernia’s intraparietal location which leads to vague symptoms and difficult physical examination,

especially in obese patients where the adipose panicle prevents palpation of a sac under the aponeurosis of the abdominal external oblique muscle. Because of this, if there is any doubt, we advise tomography as the most reliable test (positive sensitivity and predictable value of 100 %) to complete the preoperative diagnosis, and if this is inconclusive laparoscopy is recommended [5, 7–11]. Another interesting aspect which characterizes this hernia is the possibility of having another associated hernia, which some authors have quoted in up to 50 % of cases. This could justify the intra-abdominal laparoscopic approach as it enables a thorough exploration of the complete abdominal wall and cavity to be performed [12, 13].

Technical problem

Each of the three laparoscopic techniques has its own advantages and disadvantages, but they all share the benefits of the minimally invasive approach: less time in hospital, less infection, less scarring, and less time for functional recovery.

The TEP is the least documented technique because it is more difficult, takes longer and requires a more experienced surgeon. Although from an anatomical point of view it is theoretically the most attractive, in practical terms it has a number of limitations. These may relate to the patient (those who are obese, have had previous surgery who are not apt for general anesthetic), to the type of hernia (hernias which are high, bilateral, very large, or very small, have incarcerated content), or to the economic factor, as it requires specific instruments, which are more expensive, thereby making it less efficient. It could be the best option in elective treatment of the SH with preoperative diagnosis, but as it is not suitable for all cases and is difficult for all

Table 4 Advantages and disadvantages of extraperitoneal and intra-abdominal laparoscopic Spigelian hernia repair. Laparoscopic approach: TEP versus IPOM

	Intra-abdominal	Extraperitoneal
Surgery time	+	+++
Visibility	++++	+
Indications	Urgent and elective	Elective
Overlay (mesh)	Unlimited	Limited
Hernia type	All	Low and small
Associated surgery	Yes	No
Experience	+*	++++**
Cost effective	+++	+
Learning curve	+	+++++

(+) Likert type scale from 1 to 5, where 1+ is the lowest possible and 5+ is the highest possible (* general; ** specifically with inguinal hernia—TEP)

surgeons to reproduce, we cannot recommend it except in highly specialized centers [4, 5, 14, 15]. Our study has shown that less than 2 % of surgeons feel comfortable with this approach and that the learning curve is completed during the 5 years as a resident.

The other two intra-abdominal laparoscopic approaches, TAPP and IPOM, apart from having the classic advantages also offer other significant benefits: (1) easy, precise location of the defect, and access to its contents (which is particularly relevant as it avoids disproportionately long incisions and abdominal wall damage because of blind dissection); (2) the possibility of concomitant treatment of any other known pathology, such as an inguinal, femoral, umbilical hernia, or gall stones; (3) they permit treatment when it arises as an incidental discovery; or (4) they have also been shown to be an efficient and safe option in emergencies (Table 4) [16–20].

The IPOM technique is the most commonly used procedure in the literature. This shows that it is more versatile, being well suited to any kind of presentation, and any surgeon who has been adequately trained in laparoscopic surgery, though not specifically in hernia surgery. It is the simplest option, providing the best visibility, well-known instruments, requiring least dissection to get a good view of the weak areas, and enables a larger mesh to be used without any problems extending it. These advantages are clearly reflected in our study, where 90 % of the surgeons in our country regularly perform this intervention as opposed to the 2 % who regularly perform the TEP approach. Similarly, during the length of this study 36 residents completed their training at our hospital and not one of them has, to date, performed the TEP approach at their final place of work.

In high SH and in large SH with visceral content, the orientation and dissection are more complex in the extraperitoneal space (TEP and TAPP) but fairly simple and

quick at the intra-abdominal level, where we usually work with the laparoscope. The disadvantage usually cited for this technique is the potential risk of intestinal lesions, a fact which has not yet been documented after 20 years of experience, nor have we seen it in this study. Furthermore, we now have new extra-light meshes (% of polypropylene <35 g/m²) and coated meshes, which allow for complete reperitonization with less inflammation (less irritation and final parietal rigidity) and better safety [21–23].

The TAPP shares characteristics with the previous two techniques. A priori it appears to be a good option, but the properties of this kind of hernia make its application difficult. First, the rigid ring and its lateral location mean that a complete parietal dissection is required. In addition, the peritoneum, which covers the hernia over the Spigelian fascia, tends to be very thin, friable, and adhered to the aponeurotic muscle tissue, especially in thin patients or high hernias. The flap or peritoneal pocket does not usually have sufficient fatty tissue to be separated without breaking. Neither is it simple to extend the mesh well, overlapping the defect, fix it, and replace the peritoneum, which thus requires greater surgical time. Ultimately, a surgeon with more experience of abdominal wall surgery is required [24, 25]. In our unit, this option was abandoned early on.

Which mesh and how should it be fixed?

A standard polypropylene mesh can only be used, when the peritoneum is continuously preserved (TEP and sometimes TAPP). In most cases, it is safer to use a composite or coated mesh, preferably low density, which is always safer if the IPOM option is chosen. In most cases, it is safer to choose a composite or coated mesh, preferably low density, which is always safer for the IPOM option. Although there may be peritoneum, it is worth remembering that a mesh with a high percentage of polypropylene is highly irritating, and the inflammatory reaction can affect the visceral contents, even though only indirectly, causing visceral adhesions. Our unit, which specializes in hernia treatment, has gone from using 60 gr/m² meshes to those of 35 g/m², without affecting the recurrence rate and improving patient's postoperative experience [26]. The literature seems to indicate that it is not necessary to close the defect to get good results, and more so with a hernia such as the Spigelian with a small ring and well defined muscle edges, which enable the mesh to be solidly fixed and to be completely integrated into the posterior abdominal wall. The mesh should have at least a 5-cm overlap around the complete defect perimeter, but as this is usually small, a 15-cm mesh tends to be big enough, and it is easy to handle inside the intra-abdominal cavity. As has been shown with incisional hernias, fixation using tacks is safe and reduces

the risk of pain and surgical time when compared to transmural sutures. In what is a logical evolution over recent years, our team has begun using a synthetic tissue adhesive in order to reduce the amount of foreign material used (1/2 the number of tacks). This new fixation technique has, over the last 6 years, proved to be safe, independently of the approach used, with the same recurrence rate in the long term, as well as being more efficient in that it considerably reduces cost of the process [16, 25–30].

How best to handle recurrence?

Recurrence rate in the literature varies between 5 and 14 %, with all the cases quoted being repaired by simple suture. The longest series published via open surgery was by Larson, with 70 cases, repaired using simple suture and with a recurrence rate of 4.3 %. Barnes, published the longest series of cases treated via laparoscopic surgery with 26 cases, and they describe how they had no recurrences after a median follow-up of four years. In spite of this some authors still advise limiting the use of a mesh to those cases with a defect over 2-cm long and/or with weak local tissue. We believe that the risk of recurrence is not dependent solely on the size of the hernia; there are also factors associated with the patient which cannot be controlled (related to the immune system) which suggest a mesh be used independently of the size of the hernia or evaluation of the local tissue, something which is difficult to perform during a laparoscopic intervention [13, 27].

After two decades of experience using laparoscopic surgery to treat abdominal wall hernias, both technique options have been shown to be safe and offer similar results. However, each SH is unique as is the patient presenting it, thus only the surgeon's good judgment and experience applied to each individual case will enable the correct choice of the best form of treatment. A rational choice should take into account the factors of the patient, the type of hernia and the surgeon's experience. Bearing this in mind, this study allows us to recommend an intra-abdominal laparoscopic approach as the most advisable for SH treatment. Future random studies are necessary to answer our question with more scientific evidence.

Conclusions

Laparoscopy gives good results using any of these techniques. From our experience, we suggest the IPOM as the "gold standard" technique because of the technical and economic advantages. The IPOM procedure with a lightweight titanium-coated mesh fixed using a combined technique is a highly effective option for SH repair.

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