

Original article

Impact of an abdominal wall surgery specialist on incisional hernia outcomes: A registry-based analysis



Impacto de un especialista en cirugía de la pared abdominal en los resultados de la Hernia Incisional. Análisis de un registro

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ABSTRACT

Introduction: General surgery is undergoing progressive super-specialization with conditions previously managed by general surgeons now being treated by super-specialists (SS). No universal criteria currently exist to define abdominal wall surgery super-specialization (AWS-SS), and the designation remains a self-reported classification. The aim of our paper is to evaluate the outcomes of incisional hernia (IH) procedures in the context of super-specialization or not, focusing on complications and recurrence rates.

Methods: All patients who underwent elective and emergency IH repair with mesh between 2017 and 2022 were included in the Spanish IH registry (EVEREG database). At the time of data inclusion, surgeons self-identified as either super-specialists or not (SS vs NSS), using no predefined criteria. Patients were divided into 2 groups: those performed by SS or NSS. Using a 1:1 matched analysis, differences in the incidence of complications and recurrence rates within 30 days, 6 months, one year, or 2 years of follow up were compared.

Results: A total of 6231 IH procedures were analyzed, 3441 (55.2%) of which were recorded as having been performed in the presence of a super-specialist. After matching, 4680 IH procedures were included in the final analysis. IH repairs performed in the presence of a super-specialist were associated with a lower incidence of surgical site occurrences (SSO), reduced recurrence rates within the first 2 years of follow-up, and lower rates of bulging and overall complications.

Conclusions: Involvement of a super-specialist in the repair of an IH can be associated with lower complication rates and reduced recurrence.

RESUMEN

Introducción: La cirugía general está experimentando una superespecialización progresiva. No existen criterios universales para definir a un superespecialista (SE) en cirugía de la pared abdominal (AWS SE), la designación se basa en una autodefinición por parte del cirujano. El objetivo es evaluar los resultados (complicaciones y tasas de recurrencia) de la intervención de hernia incisional (IH) en presencia o no de un SE.

Métodos: Todos los pacientes con reparación electiva y urgente de IH con malla entre 2017 y 2022 incluidos en el registro español de IH (EVEREG). Los pacientes se dividieron en dos grupos: los realizados en presencia o no de un SE. Mediante un análisis emparejado 1:1, se compararon las diferencias en complicaciones y tasas de recurrencia a los 30 días, seis meses, un año o dos años de seguimiento.

Resultados: Se analizaron un total de 6.231 procedimientos de IH. Se identificaron 3.441 (55,2%) intervenciones realizadas en presencia de un SE. Tras el emparejamiento, se incluyeron en el análisis final

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4.680 procedimientos de IH. La reparación de IH realizada en presencia de un SE se asocia a una menor incidencia de SSO, menores tasas de recurrencia en los dos primeros años de seguimiento y menores tasas de “abombamiento” y complicaciones generales.

Conclusiones: La presencia de un SE en la reparación de un IH puede asociarse a una menor tasa de complicaciones y a una menor recurrencia.

Introduction

In recent years, there has been significant progress in understanding the risk factors and preoperative care associated with abdominal wall surgery (AWS) and incisional hernia (IH) repair.¹ Surgeons have increasingly focused on optimizing preoperative, intraoperative, and postoperative management to improve patient outcomes.² It is well established that surgeons who perform high volumes of open IH repairs achieve lower reoperation rates, greater operative efficiency, and reduced overall costs.³ Additionally, increased surgical volume may influence the use of minimally invasive techniques.⁴

General surgery is undergoing progressive super-specialization, and conditions that were previously managed by general surgeons are now being treated by super-specialists (SS). This ongoing shift is likely irreversible.⁵ In recognition of this trend, the European Union of Medical Specialists (UEMS) recently established AWS as a distinct working group, leading to the creation of the European Board of Abdominal Wall Surgery.⁶ The board defines AWS as a “transferable competence” requiring both core clinical and operative skills as well as specialized expertise in the prevention and treatment of hernias and abdominal wall defects. However, it does not provide a standardized definition of super-specialization in AWS, and, to the best of our knowledge, no universal criteria currently exist.

The designation of AWS-SS remains a self-reported classification that has become increasingly widespread, despite the absence of formal, standardized criteria.⁷ Consequently, it is essential to quantify and evaluate the impact of the type of surgeon responsible for the repair of an IH.⁸

Clinical registries serve as key tools for systematically collecting, analyzing, and evaluating real-world surgical outcomes.⁹ Abdominal wall registries, in particular, have facilitated substantial advancements in hernia management, providing data from diverse surgeon cohorts and enabling the assessment of new treatment strategies.^{10,11} Access to an IH-specific registry that includes surgeon-reported SS or non-super-specialist (NSS) status presents an opportunity to analyze the impact of AWS-SS involvement in surgery. Thus, this study aims to evaluate the outcomes of IH procedures performed in the presence of super-specialization or not, focusing on complications and recurrence rates.

Methods

Study population/data source

The EVEREG registry for IH surgery was established in Spain in 2011 by the abdominal wall division of the Spanish Association of Surgery (AEC).¹² A total of 201 hospitals participated, representing 38% of hospitals in the National Health System. All hospitals participating in EVEREG have had the approval of their respective Ethics Committees for the inclusion of data and the performance of data analysis.

The methodology for data collection and storage has been previously described.¹¹ Briefly, data were collected prospectively, voluntarily, and anonymously through an online database and stored on an external server. The registry captured patient characteristics, hernia details, surgical parameters, and intraoperative and 30-day postoperative complications, including surgical site infection (SSI)

and surgical site occurrences (SSO) unrelated to infection. Each procedure was recorded using binary variables (yes/no) for complications, including surgical site pain. Follow-up assessments were recorded after 6 months, one year and 2 years, documenting hernia recurrence (defined as the reappearance of the hernia) and “bulging” (defined as swelling at the surgical site, but no confirmed hernia). Mortality rates were also recorded. Surgeons self-identified as SS or NSS, with no predefined criteria in the EVEREG database.

This study was conducted in accordance with the declaration of Helsinki, and this manuscript adheres to the STROBE guidelines for observational studies.

Inclusion and exclusion criteria

Procedures performed between 2017 and 2022 were included in the analysis. Eligible cases involved elective and emergency IH repairs using mesh, including both open and minimally invasive approaches. Records were excluded from the postoperative analysis if they lacked 30-day follow-up data and from the long-term analysis if 6-month, one-year, or 2-year data were missing.

Outcomes of interest

The primary outcomes were intraoperative complications, wound-related complications (SSI and SSO within 30 days), pain within the first 30 days, and hernia recurrence at 6 months, one year, and 2 years. The secondary outcomes included the overall complication rate, recorded as a binary variable (yes/no), as well as differences in bulging, reoperation rates, and mortality.

Statistical analysis

Interventions meeting the inclusion criteria were categorized into 2 groups: those performed in the presence of an SS or not. The association between SE involvement and primary and secondary outcomes was analyzed using Pearson’s chi-squared test or Fisher’s exact test for categorical variables and the Wilcoxon rank-sum test for continuous variables. Propensity score matching (PSM) was applied before statistical comparisons to minimize confounding. Matching was performed at a 1:1 ratio using the nearest-neighbor method with a caliper width of 0.2 standard deviations of the logit of the propensity score. Standardized mean differences (SMD) were used to evaluate the balance of baseline characteristics between the 2 groups, with an SMD of less than 10% considered indicative of an acceptable balance.

Patients were matched based on factors associated with the outcomes of interest, including age, sex, obesity status (non-obese vs BMI 30–34.9, BMI 35–39.9, or BMI > 40), ASA classification (I–II vs III–IV), diabetes, COPD, active smoking, anticoagulant use, immunosuppressant use, prior diagnosis of aortic aneurysm, previous hernia repair, transverse defect diameter (<10 cm, 10–15 cm, >15 cm), reducibility of the IH (reducible vs non-reducible), hernia location (midline vs non-midline), trocar-site or parastomal hernia, history of prior repair, loss of domain, elective vs urgent repair, minimally invasive surgery (MIS) vs open surgery, associated component separation, closure of the defect, and the performance of any additional procedure beyond IH repair.

Cases with missing values for any covariates included in the PSM model were excluded from the analysis. Statistical significance was

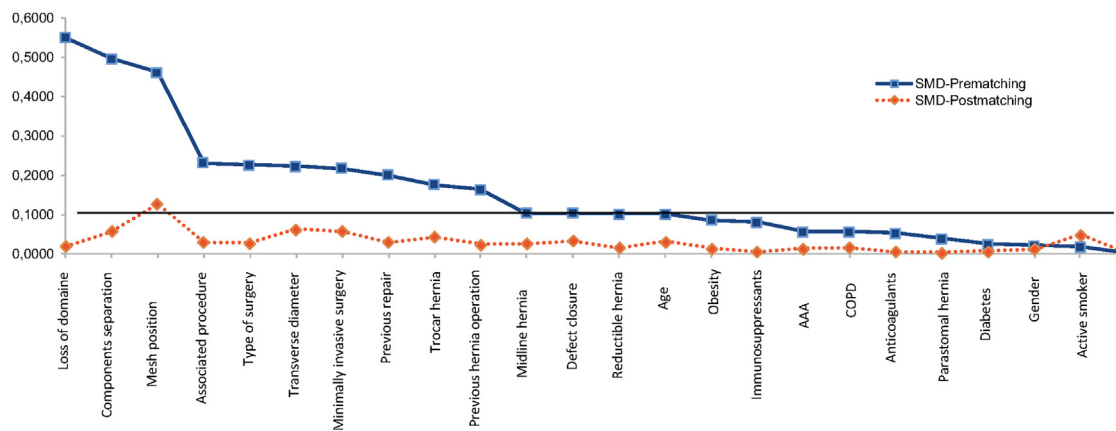


Fig. 1. Equilibrium of baseline covariates pre and postmatching. An SMD ≤ 10 indicates that the groups are well matched.

defined as $P < .05$. All analyses were conducted using SPSS version 28.0 (IBM Inc., Rochester, MN, USA).

Results

A total of 6231 IH procedures met the inclusion criteria, with data obtained from 133 centers. Among these, 3441 (55.2%) were performed in the presence of an SS. After PSM, 4680 IH procedures were included in the final analysis. Fig. 1 illustrates the SMD before and after PSM, demonstrating that an SMD of less than 10% indicates negligible covariate imbalances, suggesting that the matched groups were comparable.¹³

Table 1 presents the demographic and clinical characteristics of the study population before PSM, while Table 2 shows the same characteristics after matching. Prior to matching, statistically significant differences were observed between the SS and NSS groups across multiple variables. After matching, no significant differences remained, indicating successful homogenization of the groups. The mean age of patients was 63 years, and 53% were female. In terms of comorbidities, 54% were non-obese, 17% were active smokers, and 20% had diabetes mellitus. Regarding hernia characteristics, 57% were midline defects, and 86% had a transverse defect diameter of less than 10 cm. Trocar-site hernias accounted for 27% of cases. An open surgical approach was used in 92% of cases, and component separation was performed in 11% of procedures.

Table 3 presents the primary and secondary outcomes. In the primary outcomes, there were no statistically significant differences between the SS and NSS groups in intraoperative complications, pain within 30 days, or SSI. However, the incidence of surgical site occurrences was significantly higher in the NSS group ($P = .022$) and hernia recurrence was significantly lower in the SS group at 6 months ($P = .007$), 12 months ($P < .001$), and 24 months ($P < .001$).

Regarding secondary outcomes, no significant differences were observed in reoperation rates or mortality. However, bulging was significantly lower in the SS group ($P = .020$), as was the overall complication rate ($P = .003$).

Discussion

The analysis of our registry suggests that IH repair performed in the presence of a super-specialist is associated with a lower incidence of SSO, reduced recurrence rates within the first 2 years of follow-up, and lower rates of bulging and overall complications.

The provision of high-quality care within any organization requires individuals with the necessary competencies to perform

their roles effectively.¹⁴ Medicine, in particular, has a well-defined division of labor, which has led to its fragmentation into specialized fields over the past century.¹⁵ General surgery is one such specialty, with surgeons developing expertise in specific domains. This expertise is often defined as the ability to achieve superior performance compared to peers performing the same procedures.¹⁶ However, as surgical complexity has increased across all subspecialties, a trend toward further specialization has emerged, which appears to be irreversible.⁵ Today, a super-specialist can be identified as a surgeon with high-level competency in very specific procedures within a given specialty, who often assumes sole responsibility for those procedures at their institution.¹⁷

Numerous efforts have been made to define the attributes that determine competency in specialized surgical fields.¹⁸ While a comprehensive analysis of these factors was beyond the scope of this study, it is widely acknowledged that competency encompasses both technical and non-technical skills.¹⁹ These skills are shaped by formal training and experience and are further influenced by innate abilities, which remain difficult to quantify. A critical challenge in AWS is the lack of standardized criteria for defining SS status, with the designation currently relying solely on self-identification by surgeons. Despite this limitation, the recognition of AWS as a distinct field has led to significant changes in IH management over the past few decades. The concept of AWS-SS appears to be gaining traction in Europe, as reflected in the activities of the UEMS⁵ as well as other parts of the world, despite the absence of uniform classification criteria.^{7,20,21} Given this evolving landscape, registry-based analyses provide a key opportunity to assess real-world surgical practices and outcomes associated with AWS-SS involvement. This study represents one of the first registry-based assessments of super-specialist participation in IH repair, a key component of AWS.

A potential argument against AWS-SS involvement is that its benefits may be limited to complex hernias, as general surgery specialists already possess the necessary skills for managing non-complex cases. However, our findings suggest otherwise. Notably, 86% of the IH patients in our study had a transverse diameter of less than 10 cm, and 54% were non-obese. A transverse defect diameter greater than 10 cm and obesity are well-established factors contributing to increased IH complexity.²² Our findings suggest that AWS-SS involvement may improve outcomes in both simple and complex IH repairs. However, as these results are derived from observational data, they should be interpreted with caution. Further validation through multicenter randomized controlled trials is needed to confirm the clinical utility of AWS-SS involvement in IH surgery.

Such studies are particularly relevant in the current clinical landscape, where specialized AWS units are being proposed.^{5,23–26} However, existing data suggest that these units do not necessarily

Table 1
Demographic characteristics and pre-matching variables.

		NO SS (n = 2790)		SS (n = 3441)		P-value
		n	%	n	%	
Male		1304	46.70%	1646	47.80%	.389
Female		1486	53.30%	1795	52.20%	
ASA Classification	ASA I–II	1993	71.40%	2461	71.50%	.940
	ASA III–IV	797	28.60%	980	28.50%	
Obesity	non-obese	1518	54.40%	1831	53.20%	.011
	BMI 30–34.9	770	27.60%	1067	31.00%	
	BMI 35–39.9	373	13.40%	408	11.90%	
	BMI 40	129	4.60%	135	3.90%	
Diabetes	No	2230	79.90%	2715	78.90%	.319
	Yes	560	20.10%	726	21.10%	
COPD	No	2367	84.80%	2848	82.80%	.028
	Yes	423	15.20%	593	17.20%	
Active smoker	No	2308	82.70%	2822	82.00%	.463
	Yes	482	17.30%	619	18.00%	
Anticoagulants	No	2462	88.20%	2975	86.50%	.035
	Yes	328	11.80%	466	13.50%	
Immunosuppressants	No	2688	96.30%	3263	94.80%	.004
	Yes	102	3.70%	178	5.20%	
AAA	No	2745	98.40%	3363	97.70%	.065
	Yes	45	1.60%	78	2.30%	
Previous hernia operation	No	2111	75.70%	2364	68.70%	.000
	Yes	679	24.30%	1077	31.30%	
Transverse diameter	< 10 cm	2463	88.30%	2757	80.10%	.000
	10–15 cm	220	7.90%	466	13.50%	
	> 15 cm	106	3.80%	217	6.30%	
Reducible hernia	Yes	2406	86.30%	3088	89.80%	.000
	No	383	13.70%	352	10.20%	
Midline hernia	No	1235	44.80%	1360	39.70%	.000
	Yes	1521	55.20%	2067	60.30%	
Trocar hernia	No	1939	69.50%	2669	77.60%	.000
	Yes	851	30.50%	772	22.40%	
Parastomal hernia	No	2660	95.30%	3252	94.50%	.138
	Yes	130	4.70%	189	5.50%	
Previous repair	No	2262	81.10%	2521	73.30%	.000
	Yes	528	18.90%	920	26.70%	
Loss of domain	No	2763	99.10%	3229	93.90%	.000
	Yes	26	0.90%	211	6.10%	
Type of Surgery	Elective	2529	90.60%	3345	97.20%	.000
	Emergency	261	9.40%	96	2.80%	
Minimally invasive surgery	No	2635	94.40%	3076	89.40%	.000
	Yes	155	5.60%	365	10.60%	
Components separation	No	2550	91.40%	2667	77.50%	.000
	Yes	240	8.60%	774	22.50%	
Defect Closure	No	404	14.50%	622	18.10%	.000
	Yes	2385	85.50%	2816	81.90%	
Associated procedure	No	2521	90.40%	2877	83.60%	.000
	Yes	269	9.60%	563	16.40%	
Age (years)	< 55	774	27.70%	846	24.60%	.000
	55–64	680	24.40%	956	27.80%	
	65–74	780	28.00%	1006	29.20%	
	≥ 75	556	19.90%	633	18.40%	
Age (mean/SD)		63.1	13.2	63.4	12.3	.403

SS: Super-specialist; ASA: American Society of Anesthesiologists; COPD: chronic pulmonary obstructive disease; AAA: abdominal aortic aneurysm.

achieve superior outcomes in IH procedures.^{27,28} This raises the question of whether AWS-SS, rather than the institutional framework, is the key determinant of improved results. It is plausible that AWS-SS expertise plays a more significant role than the presence of a dedicated unit alone. A hybrid approach, where AWS-SS surgeons operate within structured AWS units, may represent the optimal model for achieving superior IH treatment outcomes.

Despite these findings supporting AWS-SS involvement, our study has several limitations. First, the EVEREG registry relies on voluntary data submission, which introduces the possibility of missing or inaccurate information. However, recent audits have confirmed the high reliability of EVEREG data.²⁹ Second, selection bias may be present, as the dataset consists of surgeons who already have a specific interest in AWS. However, these surgeons self-identified as either SS or NSS, regardless of their level of interest in AWS specialization.

Third, another potential limitation is that a higher percentage of minimally invasive surgery could have contributed to a more refined analysis of the impact of the presence of a super-specialist. Fourth, another limitation may arise from the lack of separate analysis of specific groups that could be considered different (ie, urgent, parastomal, recurrent hernias). However, these specific indications for IH surgery do not define a different pathological entity but instead represent a more complex manifestation of the same underlying disease (ie, IH). Therefore, they do not divert us from the main objective of the study, which is to analyze the overall impact of the involvement of a SS. Fifth, it has been suggested that the analysis of surgical site occurrences requiring procedural interventions (SSOPI) facilitates the standardization of wound events following ventral hernia repair.³⁰ To date, these data have not been recorded in the EVEREG database, and their inclusion may represent an improvement

Table 2
Demographic characteristics and post-matching variables.

		NO SS (n = 2340)		SS (n = 2340)		P-value
		n	%	n	%	
Male		1094	46.80%	1082	46.20%	.725
Female		1246	53.20%	1258	53.80%	
ASA Classification	ASA I–II	1693	72.40%	1692	72.30%	.974
	ASA III–IV	647	27.60%	648	27.70%	
Obesity	Non obese	1278	54.60%	1273	54.40%	.972
	BMI 30–34.9	672	28.70%	684	29.20%	
	BMI 35–39.9	295	12.60%	287	12.30%	
	BMI > 40	95	4.10%	96	4.10%	
Diabetes	No	1873	80.00%	1865	79.70%	.771
	Yes	467	20.00%	475	20.30%	
COPD	No	1982	84.70%	1969	84.10%	.600
	Yes	358	15.30%	371	15.90%	
Active smoker	No	1963	83.90%	1921	82.10%	.102
	Yes	377	16.10%	419	17.90%	
Anticoagulants	No	2057	87.90%	2053	87.70%	.858
	Yes	283	12.10%	287	12.30%	
Immunosuppressants	No	2249	96.10%	2247	96.00%	.880
	Yes	91	3.90%	93	4.00%	
AAA	No	2297	98.20%	2293	98.00%	.670
	Yes	43	1.80%	47	2.00%	
Previous hernia operation	No	1737	74.20%	1710	73.10%	.370
	Yes	603	25.80%	630	26.90%	
Transverse diameter	< 10 CM	2052	87.70%	2002	85.60%	.095
	10–15 CM	196	8.40%	234	10.00%	
	> 15 CM	92	3.90%	104	4.40%	
Reducible hernia	Yes	2100	89.70%	2087	89.20%	.536
	No	240	10.30%	253	10.80%	
Midline hernia	No	1037	44.30%	1006	43.00%	.361
	Yes	1303	55.70%	1334	57.00%	
Trocar hernia	No	1653	70.60%	1698	72.60%	.145
	Yes	687	29.40%	642	27.40%	
Parastomal hernia	No	2222	95.00%	2225	95.10%	.840
	Yes	118	5.00%	115	4.90%	
Previous repair	No	1864	79.70%	1836	78.50%	.314
	Yes	476	20.30%	504	21.50%	
Loss of domain	No	2314	98.90%	2310	98.70%	.591
	Yes	26	1.10%	30	1.30%	
Type of surgery	Elective	2233	95.40%	2247	96.00%	.312
	Emergency	107	4.60%	93	4.00%	
Minimally invasive surgery	No	2189	93.50%	2154	92.10%	.048
	Yes	151	6.50%	186	7.90%	
Components separation	No	2117	90.50%	2077	88.80%	.055
	Yes	223	9.50%	263	11.20%	
Defect closure	No	366	15.60%	392	16.80%	.302
	Yes	1974	84.40%	1948	83.20%	
Associated procedure	No	2091	89.40%	2070	88.50%	.328
	Yes	249	10.60%	270	11.50%	
Age (years)	< 55	621	26.50%	611	26.10%	.767
	55–64	591	25.30%	623	26.60%	
	65–74	673	28.80%	659	28.20%	
	≥ 75	455	19.40%	447	19.10%	
Age (mean/SD)		63.2	12.8	63.1	12.7	.684

SS: Super-specialist; ASA: American Society of Anesthesiologists; COPD: chronic pulmonary obstructive disease; AAA: abdominal aortic aneurysm.

of the database in the future. Sixth, the use of PSM could be considered a limitation, as certain demographic or operative differences not included in the matching criteria may have been lost in the matched cohort. While PSM is inherently complex,³¹ our model is based on a large patient series with a well-defined causal structure and assumptions that support its appropriate application.^{26,32} Finally, our analysis focuses solely on technical outcomes and does not evaluate non-technical skills, such as decision-making, communication, or teamwork, which are known to influence surgical performance.

In conclusion, our findings suggest that AWS-SS involvement in IH repair can be associated with lower complication rates and reduced recurrence, highlighting the potential benefits of super-specialization in abdominal wall surgery. Further studies are required to establish

standardized criteria for AWS-SS designation and to validate these findings in controlled settings.

Declaration of Generative AI and AI-assisted technologies in the writing process

The authors declare that artificial intelligence was not used to develop this paper.

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Table 3

Results of interest in the post-matching group.

		NO SS (n = 2340)		SS (n = 2340)		P-value
		n	%	n	%	
Intraoperative complications	No	2312	98.80%	2300	98.30%	.143
	Yes	28	1.20%	40	1.70%	
Complications	No	1703	75.20%	1801	78.80%	.003
	Yes	563	24.80%	484	21.20%	
Pain	No	2222	98.10%	2246	98.30%	.554
	Yes	44	1.90%	39	1.70%	
Bulging	No	2249	99.20%	2279	99.70%	.020
	Yes	17	0.80%	6	0.30%	
SSI	No	2145	94.70%	2184	95.60%	.150
	Yes	121	5.30%	101	4.40%	
SSO	No	1848	81.60%	1922	84.10%	.022
	Yes	418	18.40%	363	15.90%	
Reintervention	No	2237	98.70%	2259	98.90%	.661
	yes	29	1.30%	26	1.10%	
Exitus	No	2264	99.90%	2279	99.70%	.160
	Yes	2	0.10%	6	0.30%	
Recurrence (6 months)	No	1115	93.40%	1219	95.80%	.007
	Yes	79	6.60%	53	4.20%	
Recurrence (12 months)	No	752	87.60%	877	92.50%	< .001
	Yes	106	12.40%	71	7.50%	
Recurrence (24 months)	No	378	70.00%	456	81.00%	< .001
	Yes	162	30.00%	107	19.00%	

SS: super-specialist; SSI: surgical site infection; SSO: surgical site occurrence.

Declaration of competing interest

M López-Cano has received honoraria for consultancy, lectures, travel costs, and participation in review activities from BD, Medtronic and Gore and is a member of the Board of the European Hernia Society (unpaid). The remaining authors have no conflicts of interest to declare.

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