

# Laparoscopic Surgeons' Perspectives on Risk Factors for and Prophylaxis of Trocar Site Hernias: A Multispecialty National Survey

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## ABSTRACT

**Background and Objectives:** Although trocar site hernias (TSHs) occur in only 1.5% to 1.8% of all laparoscopic procedures, TSHs can present serious postoperative complications. The purpose of this study was to survey surgeons who are active members of the Society of Laparoendoscopic Surgeons (SLS) to elicit their experiences with TSHs, including fascial closure preferences.

**Methods:** After reviewing the clinical and epidemiological literature to compile relevant questions, an anonymous survey was designed using Qualtrics web-based software. The survey link was emailed to all SLS members. Descriptive analyses included frequencies, percentages, and  $\chi^2$  or Fisher's exact tests to assess statistical associations.

**Results:** There were 659 SLS members who completed the survey: 323 general surgeons, 242 gynecologists, 45 colorectal surgeons, 25 bariatric surgeons, and 24 urologists. Nearly 7 in 10 respondents (68.4%) reported at least 1 patient developing a TSH within the previous decade. Compared with other specialties, bariatric surgeons had the smallest proportion of respondents reporting fascial closure for 10- to 12-mm trocars (68%) and the largest proportion indicating no fascial closure for trocars of any size (28%) ( $P < .01$ ). Among all respondents, 86.6%, 15.3%, and 2.4% close 10- to 12-mm, 8-mm, and 5-mm ports, respectively, without differences according to sur-

gical volume or practice setting. Approximately 6% reported no fascial closure for any size.

**Conclusion:** Port size remains one of the main risk factors for TSH development, with most respondents closing only 10- to 12-mm ports regardless of surgical volume or practice setting. The general trend for port closure for bariatric surgeons is significantly different from that of other surgeons.

**Key Words:** Trocar site hernia, Laparoscopy.

## INTRODUCTION

Compared with open abdominal surgery, laparoscopic approaches have provided substantial benefit to patients by reducing postoperative pain, decreasing length of hospitalization, improving scar comesis, and reducing the time to return to normal activity.<sup>1,2</sup> Postoperative formation of trocar site hernias (TSHs) is a rare but potentially serious complication of laparoscopic procedures. Most TSHs appear within the first 2 postoperative weeks, but they can clinically present as late as 1 year after the index procedure.<sup>2</sup> The estimated prevalence of TSHs among laparoscopic cases is 1.5% to 1.8%, with the most common TSH-related complications occurring at the umbilical port site.<sup>1</sup>

The presentation of TSHs may occur within the first 2 postoperative days with symptoms of bowel strangulation or several months later as bulging of the abdominal wall. Despite the low incidence of TSHs, the potential need for reparative procedures is an important concern. Although meta-analyses are limited, several retrospective cohort studies suggest that risk factors associated with TSH formation include patient factors such as female sex, older age, and increased body mass index,<sup>3,4</sup> as well as surgical factors including duration of the index surgical procedure and size of the trocar incision.<sup>3,5</sup> Despite the advances in surgical technology (e.g., bladeless trocars and port closure devices), we currently lack data on surgeons' perceptions on how these risk factors actually impact their surgical practice, TSH prevalence across specialties, years in practice, previous experience with laparoscopic proce-

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**Table 1.**  
Respondent Demographics

	Primary specialty												p Value
	All	Gynecology		General Surgery		Urology		Colorectal Surgery		Bariatric Surgery			
	n	%	n	%	n	%	n	%	n	%	n	%	
Overall	659	100.0	242	100.0	323	100.0	24	100.0	45	100.0	25	100.0	<.01
Sex													
Male	541	82.1	154	63.6	305	94.4	23	95.8	38	84.4	21	84.0	
Female	118	17.9	88	36.4	18	5.6	1	4.2	7	15.6	4	16.0	
Age, yr													.28
Early (25–44)	143	21.7	47	19.4	74	22.9	8	33.3	9	20.0	5	20.0	
Mod (45–54) <sup>^</sup>	215	32.6	78	32.2	97	30.0	10	41.7	19	42.2	11	44.0	
Senior (55+)	301	45.7	117	48.3	152	47.1	6	25.0	17	37.8	9	36.0	
Residency training													.03
University program	433	65.7	160	66.1	206	63.8	23	95.8	32	71.1	12	48.0	
University-affiliated community program	145	22.0	56	23.1	71	22.0	1	4.2	10	22.2	7	28.0	
Community program	81	12.3	26	10.7	46	14.2	0	0	3	6.7	6	24.0	
Country of residence													<.01
United States	251	38.1	108	44.6	112	34.7	12	50.0	7	15.6	12	48.0	
Other	408	61.9	134	55.4	211	65.3	12	50.0	38	84.4	13	52.0	
Nature of current practice													<.01
Training	88	13.4	35	14.5	39	12.1	4	16.7	8	17.8	2	8.0	
Academic practice	218	33.1	63	26.0	112	34.7	16	66.7	22	48.9	5	20.0	
Private practice	353	53.6	144	59.5	172	53.3	4	16.7	15	33.3	18	72.0	
Years in practice													.57
0–15	197	29.9	74	30.6	89	27.6	8	33.3	16	35.6	10	40.0	
16+	462	70.1	168	69.4	234	72.4	16	66.7	29	64.4	15	60.0	

Note: Mod, moderate. Frequencies may not add to the total and percentages may not add to 100% due to missing data.

**Table 2.**  
Trocar Site Outcomes Per Specialty

	Primary Specialty												p Value
	All		Gynecology		General Surgery		Urology		Colorectal Surgery		Bariatric Surgery		
	n	%	n	%	n	%	n	%	n	%	n	%	
Overall	659	100.0	242	100.0	323	100.0	24	100.0	45	100.0	25	100.0	<.01
Number of TSHs													
0	208	31.6	110	45.5	76	23.5	6	25.0	13	28.9	3	12.0	
1-2	262	39.8	111	45.9	124	38.4	9	37.5	10	22.2	8	32.0	
3-4	95	14.4	15	6.2	55	17.0	3	12.5	17	37.8	5	20.0	
5+	89	13.5	5	2.1	65	20.1	5	20.8	5	11.1	9	36.0	
Length after initial surgery, wk													<.01
1-2	76	11.5	51	21.1	14	4.3	4	16.7	6	13.3	1	4.0	
3-8	78	11.8	28	11.6	39	12.1	3	12.5	1	2.2	7	28.0	
>8	259	39.3	40	16.5	174	53.9	9	37.5	23	51.1	13	52.0	
> 1 trocar site hernias developed	21	3.2	8	3.3	10	3.1	1	4.2	2	4.4	0	0	
Does not apply <sup>a</sup>	208	31.6	110	45.5	76	23.5	6	25.0	13	28.9	3	12.0	.35
Tissue retrieval at site													
Yes	212	32.2	58	24.0	123	38.1	7	29.2	12	26.7	12	48.0	
No	214	32.5	68	28.1	108	33.4	9	37.5	20	44.4	9	36.0	
Does not apply <sup>a</sup>	208	31.6	110	45.5	76	23.5	6	25.0	13	28.9	3	12.0	<.01
Most common TSH site													
Umbilical or periumbilical	466	70.7	158	65.3	250	77.4	10	41.7	30	66.7	18	72.0	
Lateral	165	25.0	78	32.2	55	17.0	12	50.0	14	31.1	6	24.0	
Trocar size for fascial closure, mm <sup>b</sup>													
None	39	5.9	10	4.1	15	4.6	4	16.7	3	6.7	7	28.0	<.01
5	16	2.4	6	2.5	9	2.8	0	0	0	0	1	4.0	.71
8	101	15.3	39	16.1	51	15.8	2	8.3	9	20.0	0	0	.17
10-12	571	86.6	212	87.6	283	87.6	18	75.0	41	91.1	17	68.0	.02
Fascial closure device													.04
Never used	191	29.0	60	24.8	104	32.2	5	20.8	18	40.0	4	16.0	
Used previously but not currently	179	27.2	61	25.2	88	27.2	7	29.2	16	35.6	7	28.0	

**Table 2.**  
Continued

	Primary Specialty												<i>p</i> Value
	All	Gynecology		General Surgery		Urology		Colorectal Surgery		Bariatric Surgery			
	n	%	n	%	n	%	n	%	n	%	n	%	
Using currently preferred method of closure	256	38.8	110	45.5	113	35.0	10	41.7	10	22.2	13	52.0	<.01
Fascial closure device	187	28.4	89	36.8	70	21.7	10	41.7	7	15.6	11	44.0	
Manual closure	439	66.6	142	58.7	235	72.8	12	50.0	37	82.2	13	52.0	

Note: Frequencies may not add to the total and percentages may not add to 100% due to missing data.

<sup>a</sup> The “does not apply” category is based on conditional coding logic; based on a response to a previous question, a response was not expected. This category is excluded when determining the *p* value assessing the association between that variable and primary specialty.

<sup>b</sup> The values listed under this variable were not mutually exclusive but were “check all that apply.” Therefore, frequencies are expected to add to more than the total and percentages to > 100%. The *p* values for these variables were assessed for each individual response to determine whether the proportion of respondents who answered affirmatively differed across specialty subtypes.

dures, and clinical decisions for which there appears to be a lack of consensus. For example, although it has been suggested that the closure of the fascia is required only in bladeless trocar incisions of 12 mm,<sup>6</sup> common surgical practice includes fascial closure of port site incisions measuring  $\geq 10$  mm.<sup>4,7</sup> Consensus has not been reached regarding the necessity of closing smaller port sites.<sup>8</sup> To address this gap in the literature, we designed a survey to administer to surgeons who are active members of the Society of Laparoendoscopic Surgeons (SLS) in order to elicit their experiences with TSHs, nature of current practice, surgical volume, fascial closure preferences, and perceived importance of TSH risk factors.

## METHODS

A survey was developed using Qualtrics, a web-based survey development and administration system. After obtaining exempt status from University of South Florida Institutional Review Board, the survey was pretested to ensure questions were relevant and easy to understand and to gauge the time required to complete the survey. The final survey (Appendix) was sent by email to all SLS members (approximately 1769). After the initial email was sent, 2 additional reminders were sent to improve the likelihood of response. The first section of the survey focused on demographics and the participants' residency training program, nature of their current practice, surgical volume, and number of years in practice. The second section focused on participants' experience with TSH in the past 10 years. The survey also contained questions eliciting experience and preference for manual fascial closure versus fascial closure devices. All responses were kept anonymous.

Survey responses were exported directly from Qualtrics into SAS, version 9.4 (SAS Institute, Inc., Cary, NC). Survey responses were summarized primarily using descriptive statistics including frequencies and percentages. We used  $\chi^2$  tests or, because of potentially small cell sizes, Fisher's exact tests or Freeman-Halton tests to assess the statistical significance of associations between each pair of categorical variables (e.g., whether preferred method of fascial closure differed by total number of TSHs encountered). Based on our adoption of a 5% type I error rate, a *p* value of < .05 was considered statistically significant.

## RESULTS

A total of 659 SLS members participated in the survey study: 323 general surgeons, 242 gynecologists, 45 colorectal surgeons, 25 bariatric surgeons, and 24 urologists.

**Table 3.**  
Trocar Site Outcomes per Method of Fascial Closure

	All		Preferred Method of Fascial Closure				<i>p</i> Value
			Fascial Closure Device		Manual Closure		
	n	%	n	%	n	%	
Total	626	100.0	187	100.0	439	100.0	
Number of TSHs							.19
0	202	32.3	62	33.2	140	31.9	
1–2	249	39.8	79	42.2	170	38.7	
3–4	93	14.9	19	10.2	74	16.9	
5+	82	13.1	27	14.4	55	12.5	
Length after initial surgery, wk							.02
1–2	74	11.8	27	14.4	47	10.7	
3–8	76	12.1	31	16.6	45	10.3	
>8	253	40.4	61	32.6	192	43.7	
>1 trocar site hernias developed	21	3.4	6	3.2	15	3.4	
Does not apply <sup>a</sup>	202	32.3	62	33.2	140	31.9	
Fascial closure device							<.01
Never used	191	30.5	5	2.7	186	42.4	
Used previously but not currently	179	28.6	25	13.4	154	35.1	
Using currently	256	40.9	157	84.0	99	22.6	

Note: Frequencies may not add to the total and percentages may not add to 100% due to missing data.

<sup>a</sup> The “does not apply” category is based on conditional coding logic; based on a response to a previous question, a response was not expected. This category is excluded when determining the *p* value assessing the association between that variable and preferred method of fascial closure.

Most respondents reported receiving residency training at a university program (65.7%) rather than a university-affiliated community program (22%) or community program (12.3%). Only one-third of respondents were US residents. More than half of respondents reported being in private practice, 33.1% were in academic practice, and 13.4% were in training; however, there was variation by primary specialty with most respondents in urology and bariatric surgery indicating being in an academic practice (66.7% and 48.9%, respectively) (*P* < .01) (**Table 1**).

More than 70% of total respondents reported 2 or fewer patients who developed a TSH within the past 10 years. We observed substantial variation by specialty—56% of bariatric surgeons reported 3 or more patients developing a TSH in the past decade, whereas nearly half of gynecologic surgeons reported no patients with a TSH (*P* < .01). Among participants indicating that a TSH had occurred, 39% reported that the complication developed > 8 weeks

after the initial surgery (*P* < .01). More than 1 in 5 gynecologists reported that TSHs occurred in the first 1 to 2 weeks after surgery, representing 67% of all surgeons reporting the early development of TSH (*P* < .01).

About two-thirds of subspecialties report TSHs occurring in the umbilical sites, except for urologists, of whom about 50% reported TSHs occurring in the lateral ports (*P* < .01). Most respondents indicated closing fascia for trocar sizes > 10 mm (86.6%), and 15.3% reported also closing fascia for 8-mm trocars. Compared with other specialties, bariatric surgeons had the smallest proportion of respondents reporting fascial closure for 10- to 12-mm trocars (68%) and the largest proportion indicating no fascial closure for trocars of any size (28%) (*P* < .01). Despite most respondents (66%) reporting that they currently use or have used fascial closure devices, most of them preferred manual closure (66.6%) compared with a fascial closure device, although we observed variation in

the fascial versus manual closure preference by specialty ( $P < .01$ ) (**Table 2**).

Among the surgeons preferring manual closure, 42.4% reported having never used a fascial closure device. There was no significant difference in the number of TSHs reported by preferred method of closure ( $P = .19$ ). Nearly 44% of surgeons who preferred manual closure reported patients developing a TSH  $> 8$  weeks after the initial procedure, compared with 32.6% of surgeons preferring fascial closure device ( $P = .02$ ) (**Table 3**).

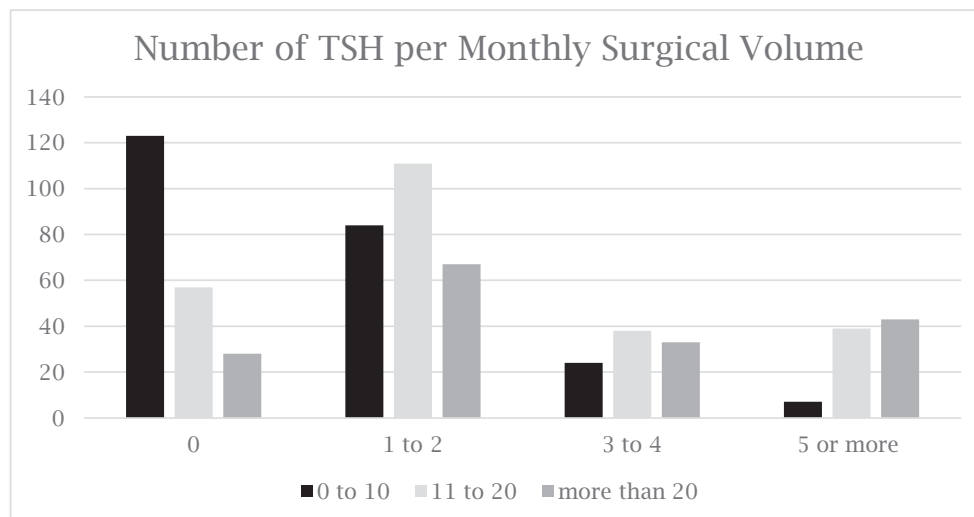
The number of TSHs reported positively correlated with the number of reported laparoscopic procedures performed monthly (**Figure 1**). Less than 3% of low-volume (0–10 procedures per month) surgeons reported  $\geq 5$  TSHs in the past 10 years compared with 15% of moderate-volume (11–20 procedures per month) surgeons and 25% of high-volume ( $> 20$  procedures per month) surgeons ( $P < .01$ ).

Among those reporting at least one TSH, surgical volume did not significantly impact the latency between the surgery and development of the TSH. Two-thirds of gynecologic surgeons reported TSHs at the umbilical port site regardless of surgical volume. Nearly 9 in 10 gynecologic surgeons reported closing 10 to 12 mm in diameter, without significant differences by surgical volume. Despite 58.7% of gynecologic surgeons indicating manual closure as their preferred method of fascial closure, about 45.5% reported current use of a fascial closure device (**Table 4**).

Almost 30% of general surgeons with a laparoscopic procedure volume of  $> 20$  per month reported  $\geq 5$  patients developing a TSH within the past decade, compared with 3.6% of surgeons with a low surgical volume ( $P < .01$ ). There was a significant difference in preferred method of fascial closure according to surgical volume, with 80.7% of general surgeons with a low surgical volume preferring manual closure compared with 60.6% of general surgeons with a high surgical volume ( $P < .01$ ). A greater proportion of high-volume surgeons reported current use of a fascial closure device (43.3%), whereas 39.8% of low-volume surgeons reported never using an assistive device ( $P = .04$ ) (**Table 5**).

## DISCUSSION

As might be expected, the number of TSHs reported correlated positively with surgical volume; however, we were unable to compare the degree to which the TSH rate varied with surgical volume. This was a result of the survey's categorical design to decrease participant burden and to minimize the potential for misclassification. The literature suggests that an inverse relationship exists between surgical volume and the rate of operative complications. In a systematic review of 14 peer-reviewed studies with 741,760 patients, Mowat et al.<sup>9</sup> demonstrated an increased rate of total complications (odds ratio [OR] 1.3, 95% confidence interval [CI] 1.2–1.5), intraoperative complications (OR 1.6, 95% CI 1.2–2.1), and postoperative complications (OR 1.4, 95% CI



**Figure 1.** Number of TSHs per monthly surgical volume. Although most surgeons reporting  $\leq 2$  TSHs in the past 10 years, the proportion of surgeons reporting this low incidence of TSHs was significantly different according to surgical volume ( $P < .01$ ).

**Table 4.**  
Trocar Site Outcomes per Surgical Volume, Among Gynecologists Only

	Laparoscopic Procedures per Month								<i>p</i> Value
	All		0-10		11-20		>20		
	n	%	n	%	n	%	n	%	
Overall	242	100.0	124	100.0	76	100.0	42	100.0	
Number of TSHs									<.01
0	110	45.5	75	60.5	24	31.6	11	26.2	
1-2	111	45.9	43	34.7	44	57.9	24	57.1	
3-4	15	6.2	5	4.0	6	7.9	4	9.5	
5+	5	2.1	1	0.8	2	2.6	2	4.8	
Length after initial surgery, wk									.74
1-2	51	21.1	21	16.9	20	26.3	10	23.8	
3-8	28	11.6	9	7.3	10	13.2	9	21.4	
>8	40	16.5	15	12.1	16	21.1	9	21.4	
>1 trocar site hernias developed	8	3.3	2	1.6	5	6.6	1	2.4	
Does not apply <sup>a</sup>	110	45.5	75	60.5	24	31.6	11	26.2	
Tissue retrieval at site									.61
Yes	58	24.0	23	18.5	24	31.6	11	26.2	
No	68	28.1	24	19.4	26	34.2	18	42.9	
Does not apply <sup>a</sup>	110	45.5	75	60.5	24	31.6	11	26.2	
Most common TSH site									.90
Umbilical or periumbilical	158	65.3	83	66.9	48	63.2	27	64.3	
Lateral	78	32.2	39	31.5	26	34.2	13	31.0	
Trocar size for fascial closure, mm <sup>b</sup>									
None	10	4.1	4	3.2	3	3.9	3	7.1	.54
5	6	2.5	4	3.2	2	2.6	0	0	.51
8	39	16.1	17	13.7	17	22.4	5	11.9	.19
10-12	212	87.6	111	89.5	65	85.5	36	85.7	.65
Considered risk factors <sup>b</sup>									
Obesity	156	64.5	88	71.0	40	52.6	28	66.7	.03
Age	61	25.2	35	28.2	12	15.8	14	33.3	.06
Smoking history	91	37.6	59	47.6	21	27.6	11	26.2	<.01
Diabetes	69	28.5	42	33.9	18	23.7	9	21.4	.16
Specimen retrieval via port site incision	85	35.1	44	35.5	25	32.9	16	38.1	.85
Longer operative time	32	13.2	17	13.7	9	11.8	6	14.3	.91
Trocar size	202	83.5	104	83.9	63	82.9	35	83.3	.98
Fascial closure device									.48
Never used	60	24.8	36	29.0	14	18.4	10	23.8	
Used previously but not currently	61	25.2	32	25.8	18	23.7	11	26.2	
Using currently	110	45.5	52	41.9	40	52.6	18	42.9	

**Table 4.**  
Continued

	Laparoscopic Procedures per Month								<i>p</i> Value
	All		0-10		11-20		>20		
	n	%	n	%	n	%	n	%	
Preferred method of closure									.30
Fascial closure device	89	36.8	43	34.7	33	43.4	13	31.0	
Manual closure	142	58.7	77	62.1	39	51.3	26	61.9	

Note: Frequencies may not add to the total and percentages may not add to 100% due to missing data.

<sup>a</sup> The “does not apply” category is based on conditional coding logic; based on a response to a previous question, a response was not expected. This category is excluded when determining the *p* value assessing the association between that variable and number of laparoscopic procedures per month.

<sup>b</sup> The values listed under this variable were not mutually exclusive but were “check all that apply.” Therefore, frequencies are expected to add to more than the total and percentages >100%. The *p* values for these variables were assessed for each individual response to determine whether the proportion of respondents who answered affirmatively differed by number of laparoscopic procedures per month.

1.3–1.4) for low-volume gynecologic surgeons compared with high-volume gynecologic surgeons. Wallenstein et al.<sup>10</sup> examined gynecologic laparoscopic procedures specifically, finding that patients undergoing procedures with high-volume surgeons had a lower risk of complication compared with patients undergoing procedures with low-volume surgeons by 25% (risk ratio 0.75, 95% CI 0.68–0.82). On the other hand, studies pertaining to surgical volume in general surgery place emphasis on surgeon use of laparoscopy<sup>11</sup> and surgical volume of the hospital<sup>12,13</sup> as predictors of fewer patient complications.

Our survey results indicated that a smaller proportion of bariatric surgeons close trocar sites of 10 mm compared with clinicians of any other specialty and that bariatric surgeons were more likely to refrain from fascial closure of any port size. As expected for this specialty, which operates on a patient population with a high rate of comorbidities correlating with obesity and the metabolic syndrome, a greater proportion of bariatric surgeons reported  $\geq 5$  TSH complications in the past 10 years compared with any other group of surgeons. However, in a retrospective study conducted by Pilone et al.,<sup>14</sup> the rate of TSH was 1.6% for 624 bariatric patients undergoing laparoscopic procedures without fascial closure. This proportion is consistent with values reported in the literature for TSHs after any laparoscopic procedure.<sup>1</sup> All TSHs in this study occurred at port sites of 10 mm or greater, but the low rate of this complication suggests that leaving the fascia open is a

viable option rather than blind suturing and risking injury to abdominal organs. It is possible that TSH in bariatric patients is underreported due to asymptomatic hernias being plugged with fat and nonpalpable defects due to body habitus.<sup>15</sup>

Few data are available regarding the incidence of TSHs with versus without specimen removal from the port site, regardless of surgical specialty. The stretching of port sites may increase the risk of hernia formation but may allow en bloc specimen removal and decrease the risk of cancerous seeding of the abdomen via morcellation into smaller pieces. Our study failed to find statistically significant associations between TSH development and tissue extraction at the site or port location. Participants were not asked about specific methods for specimen removal such as retrieval bags, morcellation, or mini-laparotomy.

Similarly, we did not find a statistically significant association between fascial closure preferences and TSH development. While a handful of devices are available to facilitate reapproximation of the fascia, the benefit of such devices has yet to be proved. Advances in surgical technology including bladeless trocars and port closure devices appear to reduce the risk of TSH, but studies comparing the effectiveness of such available devices are limited. Radially expanding blunt trocars have been shown to reduce incidence of TSH and other postoperative and perioperative complications because traumatic separation of the tissue planes is reduced.<sup>16–18</sup>



**Table 5.**  
Trocar Site Outcomes per Surgical Volume, Among General Surgeons Only

	Laparoscopic Procedures per Month								p Value
	All		0-10		11-20		>20		
	n	%	n	%	n	%	n	%	
Overall	323	100.0	83	100.0	136	100.0	104	100.0	
Number of TSHs									<.01
0	76	23.5	36	43.4	25	18.4	15	14.4	
1-2	124	38.4	31	37.3	57	41.9	36	34.6	
3-4	55	17.0	12	14.5	21	15.4	22	21.2	
5+	65	20.1	3	3.6	31	22.8	31	29.8	
Length after initial surgery, wk									.61
1-2	14	4.3	2	2.4	5	3.7	7	6.7	
3-8	39	12.1	7	8.4	20	14.7	12	11.5	
>8	174	53.9	34	41.0	80	58.8	60	57.7	
>1 trocar site hernias developed	10	3.1	1	1.2	3	2.2	6	5.8	
Does not apply <sup>a</sup>	76	23.5	36	43.4	25	18.4	15	14.4	
Tissue retrieval at site									.97
Yes	123	38.1	23	27.7	55	40.4	45	43.3	
No	108	33.4	20	24.1	50	36.8	38	36.5	
Does not apply <sup>a</sup>	76	23.5	36	43.4	25	18.4	15	14.4	
Most common TSH site									.19
Umbilical or periumbilical	250	77.4	69	83.1	102	75.0	79	76.0	
Lateral	55	17.0	9	10.8	28	20.6	18	17.3	
Trocar size for fascial closure, mm <sup>b</sup>									
None	15	4.6	5	6.0	3	2.2	7	6.7	.20
5	9	2.8	6	7.2	2	1.5	1	1.0	.02
8	51	15.8	15	18.1	17	12.5	19	18.3	.38
10-12	283	87.6	69	83.1	126	92.6	88	84.6	.06
Considered risk factors <sup>b</sup>									
Obesity	235	72.8	53	63.9	101	74.3	81	77.9	.09
Age	62	19.2	14	16.9	31	22.8	17	16.3	.37
Smoking history	127	39.3	29	34.9	56	41.2	42	40.4	.63
Diabetes	93	28.8	28	33.7	38	27.9	27	26.0	.49
Specimen retrieval via port site incision	127	39.3	23	27.7	59	43.4	45	43.3	.04
Longer operative time	17	5.3	4	4.8	8	5.9	5	4.8	.91
Trocar size	229	70.9	56	67.5	95	69.9	78	75.0	.50
Fascial closure device									.04
Never used	104	32.2	33	39.8	46	33.8	25	24.0	
Used previously but not currently	88	27.2	26	31.3	35	25.7	27	26.0	
Using currently	113	35.0	19	22.9	49	36.0	45	43.3	

**Table 5.**  
Continued

	Laparoscopic Procedures per Month								<i>p</i> Value
	All		0-10		11-20		>20		
	n	%	n	%	n	%	n	%	
Preferred method of closure									<.01
Fascial closure device	70	21.7	11	13.3	25	18.4	34	32.7	
Manual closure	235	72.8	67	80.7	105	77.2	63	60.6	

Note: Frequencies may not add to the total and percentages may not add to 100% due to missing data.

<sup>a</sup> The “does not apply” category is based on conditional coding logic; based on a response to a previous question, a response was not expected. This category is excluded when determining the *p* value assessing the association between that variable and number of laparoscopic procedures per month.

<sup>b</sup> The values listed under this variable were not mutually exclusive but were “check all that apply.” Therefore, frequencies are expected to add to more than the total and percentages >100%. The *p* values for these variables were assessed for each individual response to determine whether the proportion of respondents who answered affirmatively differed by number of laparoscopic procedures per month.

The strengths of our study include the ability to survey a large sample representative of academic and private practice surgeons in multiple specialties. The broad scope of questions allowed collection of descriptive data on rate of TSH development and fascial closure preferences. Weaknesses include format rigidity (e.g., capturing categorized value ranges instead of specific numbers) and, as a result, sacrificing depth of inquiry for likelihood of response. By asking about the development of this rare complication over a 10-year period, it is likely that recall difficulties have resulted in some misclassification and imperfect estimation of various factors.

## CONCLUSION

Nearly 70% of respondents had a patient with a TSH complication, with increased surgical volume directly proportional to TSH development. Port size remains one of the main risk factors for TSH development, with most respondents closing only 10- to 12-mm ports irrespective of surgical volume or practice setting. This study compiled observational data regarding an uncommon complication and serves as impetus for future study on surgical practices.

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