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Revisional surgery after failed esophagogastric myotomy for achalasia: successful esophageal preservation

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Abstract
Background Treatment failure with recurrent dysphagia after Heller myotomy occurs in fewer than 10 % of patients, most of whom will seek repeat surgical intervention. These reoperations are technically challenging, and as such, there exist only limited reports of reoperation with esophageal preservation.
Methods We retrospectively reviewed the records of patients who sought operative intervention from March 1998 to December 2014 for obstructed swallowing after esophagogastric myotomy. All patients underwent a systematic approach, including complete hiatal dissection, takedown of prior fundoplication, and endoscopic assessment of myotomy. Patterns of failure were categorized as: fundoplication failure, inadequate myotomy, fibrosis, and mucosal stricture.
Results A total of 58 patients underwent 65 elective reoperations. Four patients underwent esophagectomy as their initial reoperation, while three patients ultimately required esophagectomy. The remainder underwent reoperations with the goal of esophageal preservation. Of these 58, 46 were first-time reoperations; ten were second time; and two were third-time reoperations. Forty-one had prior operations via a trans-abdominal approach, 11 via thoracic approach, and 6 via combined approaches. All reoperations at our institution were performed laparoscopically (with two conversions to open). Inadequate myotomy was identified in 53 % of patients, fundoplication failure in 26 %, extensive fibrosis in 19 %, and mucosal stricture in 2 %. Intraoperative esophagogastric perforation occurred in 19 % of patients and was repaired. Our postoperative leak rate was 5 %. Esophageal preservation was possible in 55 of the 58 operations in which it was attempted. At median follow-up of 34 months, recurrent dysphagia after reoperation was seen in 63 % of those with a significant fibrosis versus 28 % with inadequate myotomy, 25 % with failed wrap, and 100 % with mucosal stricture ($p = 0.10$).
Conclusions Laparoscopic reoperation with esophageal preservation is successful in the majority of patients with recurrent dysphagia after Heller myotomy. The pattern of failure has implications for relief of dysphagia with reoperative intervention.

Keywords Achalasia · Heller myotomy · Revisional · Laparoscopic · Esophageal preservation

Achalasia is a disorder of the esophagus which is characterized by a combination of aperistalsis and loss of lower esophageal sphincter (LES) relaxation. The most common clinical signs associated with this disease are dysphagia, chest pain, regurgitation, and weight loss. The common goal for all treatment modalities of achalasia is to allow for adequate emptying of the esophagus. Treatment can be by endoscopic or surgical means. Endoscopic intervention is usually done with either botulinum toxin injections to paralyze the hypertensive LES muscle fibers or pneumatic balloon dilation to

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physically tear the LES fibers. Surgical intervention is by Heller esophagogastric myotomy, in an open or laparoscopic approach through the thoracic or abdominal cavity.

It has been reported that 90 % of patients with achalasia have had good to excellent long-term results after Heller myotomy and a combined antireflux procedure [1–8]. The surgical approach is therefore considered definitive therapy for achalasia and "first-line" therapy in those patients under the age of 40 years [1]. Recurrent dysphagia is considered treatment failure after Heller myotomy and occurs in fewer than 10 % of patients. Most patients with recurrent dysphagia will seek re-intervention, either by dilation or by reoperation. Many reports of reoperative therapy for achalasia treatment failure consider esophagectomy as the principle procedure. There exist limited reports of reoperation with esophageal preservation in such patients [2–10]. Despite this, there is a growing trend in high-volume centers for reoperation with the goal of esophageal preservation. Some centers are gaining enough experience to identify factors that are predictive of reoperative outcome. We report our institution's experience of 58 patients who presented to our hospital with symptomatic failure after initial treatment of achalasia with Heller myotomy, seeking operative reintervention.

Materials and methods

Our design is a Human Investigations Committee approved (#10-007572) retrospective cohort study from a single tertiary-care referral center. From March 1998 through December 2014, sixty-five patients seeking surgical intervention were evaluated by one of the three surgeons for symptomatic treatment failure after a prior Heller myotomy performed for achalasia (Fig. 1). Electronic medical records (EMR) were reviewed retrospectively.

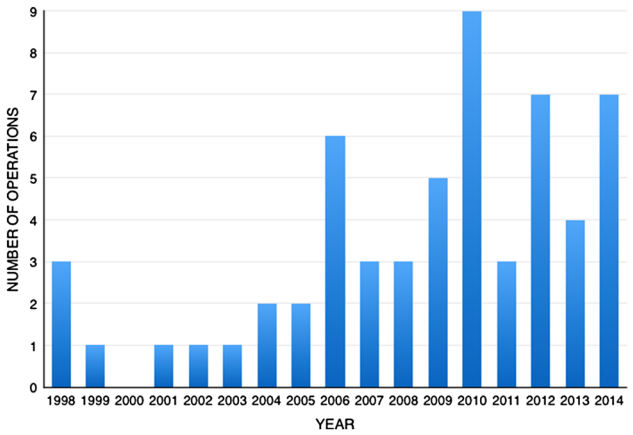

Fig. 1 Volume of redo operation per year ($n = 58$, excluding four esophagectomies as initial operation and three eventual esophagectomies)

Data were maintained on a Numbers (Apple, Cupertino, CA, USA) spreadsheet and analyzed using Fisher exact test for categorical variables. Numerical data are presented as median with designated range or as mean ± standard deviation (SD), and continuous data are analyzed using Student's t test. Type-one error threshold was set at 0.05. Patient demographics are presented in Table 1. Figure 2 illustrates our patient referral (internal versus external) and clinical path while being treated at our institution. The majority of patients (73 %) had their initial operation(s) at an outside institution. Twelve patients underwent their second reoperation, and two patients underwent their third reoperation for achalasia at our institution. The remaining patients underwent their first reoperation at our institution. The majority of patients (44) had undergone a previous trans-abdominal laparoscopic approach, while twelve patients underwent a prior thoracic approach and six had some combination of the two with regard to their prior operations.

Four patients underwent esophagectomy as their initial reoperation at our institution. Three were found to have sigmoid mega-esophagus due to end-stage achalasia and another patient had a non-dilatable peptic stricture. 58 patients were deemed suitable candidates for esophageal preservation and underwent a redo operation. An additional three patients required esophagectomy after failure of their redo operation at our institution. Our operative approach for esophageal preservation was to proceed with a takedown of their previous fundoplication, dissect out the hiatus and associated periesophageal fibrosis, and assess the need for an extension or revision of the myotomy. Dissection of the hiatus is started at the base of the left and right crura, and only after the hiatal contents are encircled and controlled is the site of prior myotomy dissected off the liver and phrenoesophageal ligament. Sharp dissection is used to minimize thermal injury to the myotomized esophageal submucosa. The prior fundoplication is then taken down, and intraoperative endoscopy is used to confirm the location of the squamo-columnar junction, identify any

Table 1 Patient demographics

	All patients ($n = 65$)
Gender	
Female (%)	38 (58 %)
Male (%)	27 (42 %)
Ethnicity	
Caucasian (%)	52 (80 %)
African-American (%)	10 (15 %)
Other (%)	3 (5 %)
Median age (range)	51 years (17–82)
Time from last operation (range)	32 months (1–480)

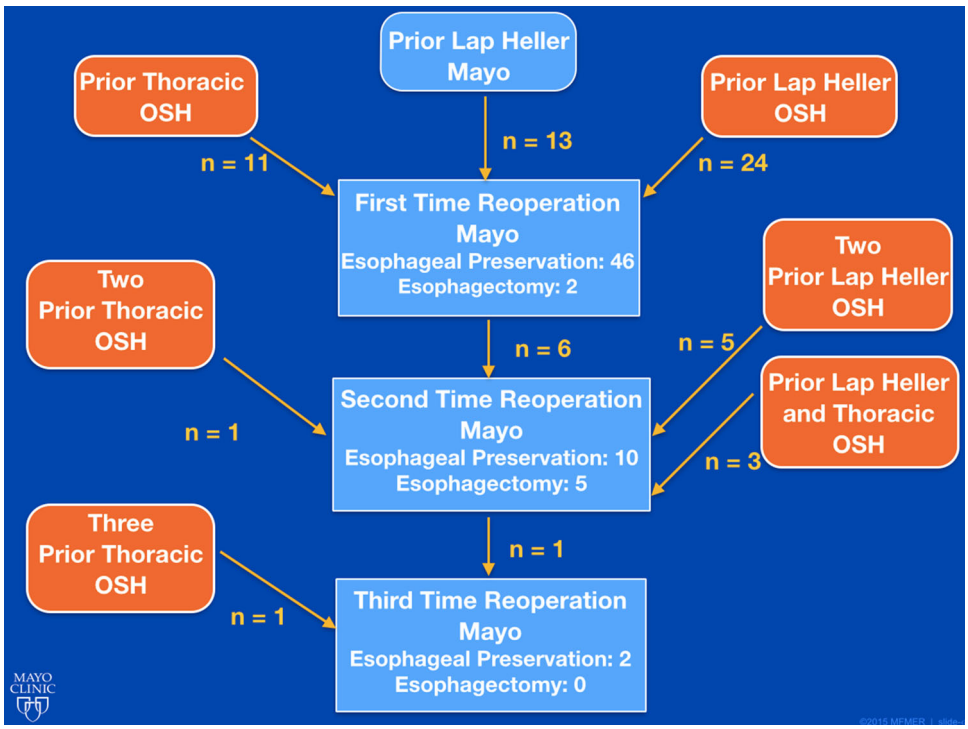

Fig. 2 Patient accrual and operative path. *Lap* laparoscopic, *OSH* outside hospital, *Mayo* Mayo Clinic of Florida

esophagogastric perforations, and assess the need to revise or extend the myotomy. It was left to the discretion of the operating surgeon, whether a fundoplication was reconstructed or not. Additionally, a gastrostomy tube (and/or jejunal feeding tube) was placed in selected patients with perforation or to provide gastropexy.

The EMR for each patient and operation was reviewed, with particular emphasis on the operative records, hospital course, and follow-up clinical data. Data points examined were esophageal and/or gastric perforation and pattern of prior operative failure. Additionally, the records were reviewed to determine length of overall hospital (LOS) stay, postoperative complications, any postoperative radiologic or surgical interventions and the postoperative course after discharge from the hospital, including recurrence of symptoms, and late postoperative interventions. Given that we are a tertiary referral center, many of our patients were seen for a single postoperative visit or returned to their home residence for further care and follow-up. We performed a prospective telephone survey to better assess long-term follow-up, reaching 19 of 58 patients. The telephone survey assessed presence and severity of dysphagia as well as reflux, dietary restrictions, the patients' ability to eat solids, and any interventions or further procedures for recurrent symptoms.

By examining the operative reports of each reoperation, the pattern of failure of the prior Heller myotomy was classified as follows: (1) inadequate myotomy, (2) esophageal fibrosis, (3) fundoplication failure, or (4) mucosal stricture. An inadequate myotomy was either clearly stated in the postoperative diagnosis or the operative report mentioned that on endoscopy, an incomplete myotomy was found and was either revised, extended to >2 cm below the squamo-columnar junction, or a new contralateral myotomy performed. With esophageal fibrosis, the myotomy was found to be adequate, but significant fibrosis along the prior myotomy and/or hiatus created an effective obstruction of the esophageal hiatus. In such cases, lysis of the obstructing fibrosis with contralateral myotomy was utilized. In fundoplication failure, an adequate myotomy was found; however, the wrap was either herniated or causing a severe angulation or shelf at the hiatus, again causing a functional obstruction. A mucosal stricture was determined once all esophageal smooth muscle fibers have been divided and was identified as a cause of recurrent symptoms. In some patients, a combination of two or more of the above contributed to recurrence of symptoms. These patients were classified into the group the authors felt was the most dominant, based on the operative report and findings.

Results

Between 1998 and 2014, 58 patients presented with obstructed swallowing after prior myotomy and underwent 65 reoperative procedures. Four of the patients who presented for treatment failure after Heller myotomy

underwent esophagectomy as their initial reoperation at our institution. Three of these patients presented with sigmoid megaesophagus and all underwent minimally invasive esophagectomy. Two patients recovered without incident, while the other died secondary to respiratory (aspiration event) and cardiac failure (arrhythmias) 34 days post operatively. The fourth patient had a non-dilatable peptic stricture, underwent an open Ivor–Lewis esophagectomy, and recovered without incident. Of the fifty-eight reoperations with a goal of esophageal preservation, a laparoscopic trans-abdominal approach was used in all, with only two conversions to an open procedure (the first for closure of a large gastrotomy and the second for dense abdominal adhesions). Three patients failed esophageal preservation, ultimately requiring an esophagectomy at our institution. Gastropexy with placement of a gastrostomy tube was used in six patients with five of the six having their operation within the last year and four out of the six undergoing their second reoperation.

There were no 90-day postoperative mortalities in the esophageal preservation group. The total rate of complications of Clavien class 3 or higher was 8 %, including four patients who required a return to the operating room: three for leak with one ultimately requiring esophagectomy and one for gastric distention. There were three patients who had pulmonary complications. Two patients had pleural effusions requiring drainage, and one patient had to be reintubated postoperatively for respiratory distress. There was also one patient with a cardiac arrhythmia that was treated medically. Another patient had severe gastric distention postoperatively, requiring reoperation for decompression as well as to rule out a leak, although none was found. Mean hospital stay was 3 days (range 1–24) with three readmissions.

Intraoperative esophagogastric perforation occurred in 11 of 58 (19 %) reoperations in the 54 patients undergoing planned esophageal preservation. Seven of these were managed by primary repair at the time of perforation, while two were staple-resected, being located in a redundant portion of the stomach. The final two occurrences were managed with primary repair at the time of operation with concomitant, intraoperative stent placement. Three patients had a postoperative leak (5 %). The first patient underwent his second operation for achalasia (first redo) at our institution. His leak was initially managed nonoperatively with esophageal stenting and drain placement. He eventually required an esophagectomy approximately 1 month later. The second patient underwent his fourth operation for achalasia (third time redo) at our institution. His leak was primarily repaired at a return to the operating room on postoperative day 6; this patient also developed pleural effusions requiring drainage and a DVT requiring anticoagulation. The third patient underwent his third operation for achalasia (second redo) at our institution. His leak was managed with a return to the operating room on postoperative day one with graham patch as well as esophageal stent placement, ultimately requiring TPN and multiple endoscopies for stent adjustment.

Fifteen patients were found to have esophageal obstruction secondary to fundoplication failure; these failures were due either to angulation at the hiatus secondary to a misplaced or slipped fundoplication ($n = 10$) or a hiatal hernia ($n = 5$). Of the fundoplication failure patients, the prior myotomy was felt to be adequate based on intraoperative endoscopy after complete takedown of the fundoplication, hiatal dissection, and hiatal hernia repair. In eleven patients, fundoplication was not reconstructed.

Forty-two of the 58 reoperations were classified as having persistent achalasia (inadequate myotomy or fibrosis). An inadequate myotomy was found in 31 cases, while the other eleven were found to have severe esophageal fibrosis. The 31 reoperations found to have an inadequate myotomy were addressed with distal extension only ($n = 8$), both proximal and distal extension ($n = 14$) or a contralateral myotomy ($n = 9$). Reoperations were completed by laparoscopic approach in all but one case (conversion to open). Twelve patients had their fundoplication reconstructed, and 19 were left without fundoplication. Of note, three patients in the inadequate myotomy group underwent later reoperation at our institution, again for recurrent dysphagia; one patient was found to have esophageal obstruction due to severe fibrosis 75 months after his initial reoperation, another was found to have an inadequate myotomy on the gastric side of the GE junction 73 months after her initial reoperation, and the last patient had a failed fundoplication causing outlet obstruction 29 months after her initial reoperation.

Eleven patients were found to have esophageal fibrosis at reoperation. All patients underwent a laparoscopic extensive lysis of adhesions, with particular attention paid to freeing the dense scar tissue overlying the esophagus. Of the eleven patients, four underwent a contralateral myotomy, at the site on the esophagus felt to have the least fibrosis. Three patients underwent distal extension of the myotomy, and two underwent proximal and distal extension of the myotomy. In the remaining two patients, lysis of fibrosis was all that could be performed. Fundoplication was not reconstructed in seven of these eleven patients.

One patient was found to have a mucosal stricture as the cause of her symptoms. This stricture was associated with a Shatzki's ring. In addition to releasing this stricture, she underwent distal extension of her prior myotomy with an anterior partial (Dor) fundoplication and planned postoperative endoscopic therapy.

In assessing long-term outcomes, 39 patients undergoing 42 reoperations were found to have sufficient follow-up

Table 2 Long-term follow-up ($n = 42$)

	Persistent achalasia		Fundoplication failure ($n = 8$)	Mucosal stricture ($n = 1$)
	Inadequate myotomy ($n = 25$)	Fibrosis ($n = 8$)		
Recurrent dysphagia	7 (25 %)	5 (63 %)	2 (25 %)	1 (100 %)
Required further revisional operation	4 (16 %)	1 (13 %)	0 %	0 %
Required esophagectomy	1 (4 %)	2 (25 %)	0 %	0 %

(6 months or greater). Median time to follow-up was 34 months (6–203 months). Table 2 compares clinical outcomes of the four patterns of failure identified intraoperatively: inadequate myotomy, fibrosis, fundoplication failure, and mucosal stricture. Clinical outcomes examined were recurrent dysphagia, further reoperation, and esophagectomy. Those patients in the failed fundoplication group had a trend toward less recurrent subjective dysphagia postoperatively. Those in the fibrosis group trended toward being more likely to have recurrent dysphagia ($p = 0.11$) and require esophagectomy for recurrent dysphagia ($p = 0.08$). No difference was seen when comparing clinical outcomes (dysphagia, reoperation, and esophagectomy) between those whose prior operation was via transabdominal versus thoracic versus a combined approach. Overall, 37 of 58 reoperations (64 %) were performed without reconstruction of fundoplication at reoperation. In those 27 patients without fundoplication reconstruction in whom follow-up was adequate, there were no significant differences in clinical outcomes when compared to those who were reconstructed with an anterior partial (Dor) or posterior partial (Toupet) fundoplication. Additionally, no differences in clinical outcomes were seen when comparing patients undergoing their first reoperation with those undergoing their second or third reoperation.

Discussion

While it has been established that laparoscopic Heller myotomy is the first-line treatment for patients with achalasia, the approach to the patient who needs reintervention after failed Heller myotomy is still debated. One problem is that the majority of studies published in the literature are limited by the number of patients they examined (Table 3). Our study is one of the largest experiences of reoperative interventions for failed first-line Heller myotomy therapy reported in the literature.

In dealing with this patient population, it is useful to have a standardized approach in patient evaluation and treatment. Our approach begins with evaluation of the patient, through imaging studies and/or endoscopy. This similar approach is commonly reported, but Petersen and Pellegrini [11] offer further explanation as to the importance and necessity of the different imaging and endoscopic evaluation techniques available. They found that the most important initial study for these patients is an upper GI series (UGI), followed by an upper endoscopy [11], and that through the combination of these two studies the majority of information, including the possible symptom etiology, can be obtained. A recent study by Loviscek et al. [12] corroborated the importance of UGI as the initial imaging of choice and even went as far as to suggest that outcomes of reoperation can be predicted based on this information.

While the workup for both initial and recurrent symptoms is similar, the goals for this patient population differ from those who seek first-time intervention for achalasia. When performing reoperation for failed achalasia treatments, the goal of operation shifts from complete resolution of patient symptoms to improvement in the patients' quality of life and satisfactory maintenance of an oral diet. While esophagectomy is a viable option, the authors believe that an unobstructed esophagus drained by gravity into the stomach will allow a more normal diet than any esophageal replacement and that esophageal preservation should be attempted when feasible. This philosophy makes sense to patients, and we did not have any patients, who were candidates for esophageal preservation and who opted for esophageal replacement.

When proceeding with reoperation for recurrent symptoms, there has been discussion as to the best approach. Should one use the previously entered surgical field, or approach the revisional operation via a different body cavity all together? Since the presence of scar tissue and adhesions from the previous operation are inevitable, it has been suggested to approach the revisional operation via a different body cavity, providing a fresh surgical field and potentially easier approach. In Grotenhuis et al. [13], 63 % of their patients undergoing reoperation did so via an

Table 3 Published series with >10 cases of reoperation for failed myotomy

Author/year	Patients with failed myotomy for achalasia (*n*)	Esophagectomy as first reoperation (*n*)	Operations for esophageal preservation (*n*)	Outcomes	Average follow-up (months)
Gayet/1991	43	0	43	Good in 79 % (34/43)	168
Kiss/1996	12	0	12	Good in 92 % (11/12)	NA
Ellis/1997	35	0	35	Resolution of symptoms in 66 %	NA
Bove/2001	20	0	20	Good in 75 % (15/20)	36 (minimum)
Iqbal/2006[a]	15	0	15	Resolution of dysphagia in 71 %	30
Grotenhuis/2007	19	0	19	Good symptom improvement in 50 % (9/18)	43.2
				Some overall improvement in 89 % (16/18)	
Gockel/2007	17	5	13 (in 12 patients)	Resolution of symptoms in 92 %	38
Rakita/2007	12	0	12	Excellent or good outcomes in 73 %	24.1
Schuchert/2008	16	5	11	Successful in 64 % (7/11)	NA
Pallati/2011	12	4	8	High degree of satisfaction in 88 % (7/8)	42
Loviscek/2013	43	0	43	Improvement of symptoms in 79 % (19/24)	63
Veenstra/2015	65	4	58 (in 54 patients)	Relief of clinically significant dysphagia in 64 % (27/42)	34

[a] Four patients in study had esophageal motor disorders as opposed to achalasia

alternate body cavity, per the surgeon's choice, with the goal of providing easier access and a technically less demanding procedure. This led to reduced operative times. However, there are limitations with this approach, and the authors noted several cases in which the etiology behind the recurrent symptoms could not be ascertained given the prior operative field could not be fully assessed. We saw no difference in long-term outcomes in patients who had their reoperation via the same approach as their index operation compared to those with an approach via a different body cavity. Following the same line of reasoning as above, it is not surprising that there is a renewed interest in the transoral or per-oral endoscopic myotomy (POEM) technique for reoperation [14]. A recent study by Vigneswaran et al. [14] examined the feasibility of using POEM in patients with prior failed Heller myotomy for achalasia with promising short-term results (5 months). It is the authors opinion that at best, this technique would be effective only in the 53 % of patients, those identified with an inadequate myotomy. Certainly, patients with a form of fundoplication failure would be identified on preoperative imaging and avoid an unnecessary and ineffective operation. However, those with stricture or severe fibrosis would be difficult to separate from those with inadequate myotomy in the preoperative setting. Additionally, given that median time to reoperation was 36 months (Table 1), long-term outcomes are needed before widespread adoption of this novel technique is applied to those with recurrent dysphagia post-Heller myotomy.

Although laparoscopic reoperation has a greatly increased level of complexity, this report shows that it can be safely performed. The authors use a standardized approach for hiatal dissection at reoperation, and clearly, the dissection of the myotomized esophagus off the liver and phrenoesophageal ligament is the most treacherous aspect of the operation, resulting in a higher mucosal perforation rate (19 %) than that seen at initial Heller myotomy operation. A high suspicion must be had in the operating room, and intraoperative endoscopy is essential in identifying these happenings. When identified, these lesions can be managed by primary repair (with anterior fundoplication), stapled excision, or esophageal stenting.

An important first step in any reoperation after Heller myotomy is to reestablish the "normal" anatomy. Many Heller myotomy procedures are performed concomitantly with an antireflux procedure, usually in the form of a

partial fundoplication. It is important, for both diagnostic and technical reasons, to take down the fundoplication and restore the stomach to its original anatomic position. This step allows for better visualization of the hiatus and dissection of the mediastinal esophagus to enable straightening an esophagus that may have redundancy in the mediastinum.

One of the most common etiologies of failed initial operative treatment of achalasia is an incomplete myotomy—most commonly inadequate on the gastric side [1, 6, 9, 11, 13, 15–19]. The total length of the myotomy has been a subject of debate. It is now common practice for a myotomy to be extended at a minimum of 1.5–2 cm on the stomach. Retrospective studies comparing consecutive patients who underwent standard Heller myotomy (1–2 cm gastric side) with Dor fundoplication followed by consecutive patients who underwent an extended myotomy ($\geq$3 cm gastric side) with Toupet fundoplication found that the extended myotomy with the Toupet provided superior results in terms of postoperative dysphagia [20, 21]. However, there are still surgeons who report large clinical volumes and good results with a 4 cm myotomy [22]. As we found an inadequate myotomy to be the most common classification of failure, we will continue to perform a >7 cm myotomy at initial operation for achalasia, with a >2 cm gastric myotomy. At reoperation, if the site of previous myotomy is fibrotic and not amenable to dissection, a contralateral myotomy can be performed. Petersen and Pellegrini [11] discussed performing a new myotomy to the side of the previous myotomy to take advantage of the uncut muscular layer, performing this technique successfully in 27 patients, with two patients (7 %) experiencing an intraoperative esophageal mucosal perforation that was primarily repaired. As we report here, it is our preference to reserve contralateral myotomy to patients with fibrosis at the prior myotomy site. It is important to remember that an inadequate myotomy is not the only reason for reintervention in this patient population, so extending the initial myotomy will not completely eliminate the reintervention rate.

A randomized trial comparing initial Heller myotomy alone to initial Heller plus Dor fundoplication showed that reflux, assessed via routine pH monitoring, occurred in 48 % of patients who only underwent a myotomy and in 9.5 % in patients who also underwent a Dor fundoplication [23, 24]. There exists one randomized clinical trial comparing Toupet versus Dor fundoplication after Heller myotomy, revealing no significant difference in dysphagia and regurgitation symptoms related to fundoplication type [25]. There was a trend toward more abnormal ambulatory pH testing in Dor compared to the Toupet fundoplication, but this did not reach statistical significance [25]. While there is evidence that fundoplication reduces postoperative reflux when added to a laparoscopic Heller myotomy, this finding is limited to those patients undergoing an initial operation; there are no reports assessing what benefit fundoplication may give to patients undergoing revisional operation for achalasia. While not designed to investigate a difference in outcomes between those patients undergoing fundoplication and those left without, our study results do not indicate any dramatic increase in reflux-related symptoms in those without fundoplication. We therefore conclude that it is acceptable not to reconstruct the fundoplication if the surgeon finds the fundus too fibrotic to do so without creating esophageal obstruction.

Additionally, we have found that it is paramount to ensure that the myotomized esophagus can empty by gravity. The redundancy of the esophagus above the hiatus contributes to angulation and obstruction, and we seek to straighten the esophagus by creating abundant intraabdominal esophagus with gastropexy by gastrostomy tube if needed. In this way, even patients with early sigmoid changes of the esophagus may be candidates for esophageal salvage with reoperation.

With increasing data supporting the feasibility and safety of performing reoperative intervention for failed primary Heller myotomy, the future of research in this field lies in predicting those who will benefit from such an operation. A recent study by Loviscek et al. [12] reported their data in support of esophageal preservation in this patient population. They were able to place patients into four stages based on preoperative UGI findings: stage I, straight esophagus with typical "bird beak" at the gastroesophageal junction; stage II, dilated/obstructed esophagus; stage III, marked dilation of the esophagus with no more than one curve; stage IV, more than one curve and tortuous megaesophagus. They found that symptom resolution post-reoperation correlated to the patient's preoperative UGI staging. All patients in stage I and II improved, while 75 % in stage III and 33 % in stage IV noted improvement [12]. We looked at intraoperative findings to stratify patient outcomes. Our data suggest that patients with severe fibrosis have decreased outcomes when compared to those with inadequate myotomy or failed fundoplication. Although not statistically significant, those with severe fibrosis trended toward higher rates of post intervention dysphagia as well as ultimate requirement of esophagectomy. The authors feel that in addition to preoperative imaging, the intraoperative findings also assist in stratifying which patients will have optimal outcomes.

There are obvious limitations to our study, besides it being a solely retrospective review. Unlike other reports, patient symptoms and quality of life were not objectively measured. When looking at data collection, the telephone survey provided subjective data that were susceptible to recall bias, as well as interviewer and response bias.

Because we did not perform esophageal replacement in those patients who we felt were candidates for esophageal preservation, we have no comparative group, and therefore, we cannot be certain that esophageal replacement would not yield better clinical results. Despite these limitations, we have found that laparoscopic reoperation with esophageal preservation was successful in the majority of patients with recurrent dysphagia after Heller myotomy. This study supports that more than one operative intervention can be undertaken in the face of recurrent dysphagia symptoms and that there can be a successful outcome with preservation of the esophagus.

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Compliance with ethical standards

Disclosures Dr. Smith is a member of the advisory committee for the LINX device. Dr.'s Veenstra, Goldberg, Thomas, Hinder, and Bowers have no conflict of interest.

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