

# Laparoscopic Cardiomyotomy for Achalasia: Clinical Outcomes Beyond 5 Years

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## Abstract

**Background** Laparoscopic cardiomyotomy is the most common surgical procedure for the treatment of achalasia, although few reports describe long-term surgical outcomes.

**Methods** The outcomes for 155 patients who underwent a laparoscopic cardiomyotomy with anterior partial fundoplication more than 5 years ago (July 1992 to May 2004) were determined. Patients were followed prospectively at yearly time points using a structured questionnaire which evaluated symptoms of dysphagia, reflux, side-effects, and overall satisfaction with the clinical outcome.

**Results** Clinical data were available for 125 patients. Thirteen patients died within 5 years of surgery, four were unable to complete the questionnaire, and one developed esophageal squamous cell carcinoma. Nine patients were lost to follow-up, and three would not answer the questionnaire (92.2% late follow-up). Postoperative dysphagia, odynophagia, chest pain, and heartburn was significantly improved at 1 year, 5 years, and late (5+years) follow-up, with outcomes stable beyond 12 months. Seventy-seven percent of patients reported a good or excellent result (minimal or no symptoms) at 5 years and 73% at late follow-up. At late follow-up, 90% considered they had made the correct decision to undergo surgery.

**Conclusions** At minimum 5 years follow-up, laparoscopic cardiomyotomy for achalasia achieves effective and durable relief of symptoms, and most patients are satisfied with the outcome.

**Keywords** Achalasia · Laparoscopy · Cardiomyotomy · Long-term follow-up · Esophagus · Dysphagia

## Introduction

Achalasia is an uncommon esophageal motility disorder characterized by the absence of esophageal peristalsis, a high resting lower esophageal sphincter (LES) pressure, and the inability of the LES to relax. Treatment focuses on lowering the resistance of the LES, and over the last decade laparoscopic cardiomyotomy has become the standard of care. Short-term follow-up suggests that laparoscopic

cardiomyotomy achieves excellent symptom relief.<sup>1–3</sup> Most series report only short-term results, with few reporting extended follow-up over a period of greater than 5 years. However, knowing the long-term outcome for this operation is important, as this ultimately determines its place in the treatment armamentarium for achalasia. In this study, we evaluated longer term outcomes following laparoscopic cardiomyotomy and anterior partial fundoplication in a large group of patients who were followed prospectively for at least 5 years.

## Methods

Clinical outcomes of five or more years after a primary laparoscopic cardiomyotomy with anterior partial fundoplication for achalasia were sought for all patients undergoing surgery in hospitals in Adelaide, SA, Australia. The diagnosis of primary achalasia was based on clinical

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history, barium swallow, endoscopy, and esophageal manometry. During the study period, all cardiomyotomies were attempted using a laparoscopic technique. Twenty-three patients had undergone previous failed pneumatic dilatation, whereas 132 had not undergone any prior endoscopic therapy. No patient in this experience had been treated with Botulinum toxin injection before surgery.

### Surgery Technique

Surgery was carried out by one of six upper gastrointestinal surgeons or by a surgical trainee under their direct supervision. The surgical technique has been standardized since 1992, and it has been described elsewhere.<sup>4</sup> Briefly, all procedures were initiated laparoscopically, with anterior and lateral division of the phrenoesophageal ligament to mobilize the anterior and anterolateral aspects of the lower esophagus, and the fat pad overlying the gastroesophageal junction was removed to ensure that the gastroesophageal junction was accurately identified. The aim of surgery was to divide the circular muscle of the lower 5–6 cm of the esophagus and to extend the myotomy onto the cardia of the stomach. Intraoperative endoscopy was routinely used to assess the completeness of myotomy and to identify any inadvertent intraoperative mucosal perforation. Posterior hiatal repair was only undertaken when a hiatus hernia was present. An anterior partial fundoplication was constructed in all but one patient. Postoperatively, patients were usually discharged from day 2 onwards, when able to tolerate a vitaminized diet.

### Follow-up and Outcome

Information about the preoperative assessment, surgical procedure, and postoperative outcome for each patient was collected prospectively and stored on a computerized database. Postoperative clinical follow-up was obtained using a standardized questionnaire, which was administered by a research nurse at 3 and 12 months following surgery, and then annually thereafter. The questionnaire was initially mailed to each patient, but if it was not returned and the patient could be located, data was collected by telephone interview using the same structured questionnaire. Effort was made to obtain follow-up information for every patient at the 5-year follow-up point. The questionnaire assessed symptoms of dysphagia and reflux as well as overall satisfaction with the outcome of surgery. Visual analog scales (0–10) were used to determine dysphagia for solids and dysphagia for liquids (0=no dysphagia; 10=severe dysphagia). The scores on this scale were clustered into four groups for further data analysis (0=none; 1–3=mild; 4–6=moderate; 7–10=severe). The frequency of dysphagia, odynophagia, chest pain, and heartburn was assessed

separately on a categorical scoring scale similar to that described by DeMeester (absence, occasional episodes, frequent episodes, and daily symptoms).<sup>5</sup> Patients were also asked to indicate whether they could eat a normal diet without restrictions.

A Visick score was used to assess overall outcome: Visick grade I represented no symptoms; Visick grade II, mild symptoms easily controlled; Visick grade III, moderate symptoms not controlled by simple methods; Visick grade IV, moderate symptoms which interfered with quality of life; and Visick grade V, symptoms worse than before the operation. The overall outcome was also determined using a 0–10 analog satisfaction score (0=unsatisfied, 10=very satisfied), and this was recategorized into three groups (0–3=bad outcome; 4–6=intermediate; 7–10=good outcome). On a categorical scale, patients also graded their overall outcome as excellent, good, fair, poor, and worse than before surgery. Patients were also asked whether they thought their original decision to undergo an operation had been correct. Twenty-four-hour pH studies, esophageal manometry, and endoscopy were not routinely scheduled during follow-up but were performed when clinically indicated.

### Statistical Analysis

Follow-up data at five or more years after surgery (late follow-up) were gathered and compared with preoperative data, follow-up at 1-year, and follow-up at 5-years. Statistical evaluation was undertaken using the SPSS statistical package (SPSS, Inc), with the Wilcoxon matched-pairs signed-ranks test used to test for significance between paired continuous variables. Cross-tabulated comparisons between groups of categorical variables were achieved by chi-square test, or if sample sizes were small the two-sided Fisher's exact test was applied. A difference was regarded as significant if  $p < 0.05$ .

## Results

### Demographics

Between July 1992 and April 2004, 155 patients underwent a primary laparoscopic cardiomyotomy with anterior partial fundoplication. They included 80 men and 75 women, with a median age of 48 years (range 15 to 88 years). The median operating time was 80 min (range 30–210). Postoperative hospital stay ranged from 1 to 40 days (median 3), and 89% of patients were able to be discharged within 4 days of surgery. Postoperative complications were: bleeding from a splenic injury requiring open splenectomy ( $n=1$ ), subphrenic abscess requiring percutaneous drainage ( $n=1$ ), and a leak from a myotomy requiring open surgery

**Table 1** Analog Liquid and Solid Dysphagia Scores Preoperatively and at Various Follow-Up Time Points

	Liquid score	Solid score	n
Preoperative	6.5±3.3	8.9±1.8	125
Postoperative 1 year	1.3±2.4	3.2±2.8	104
5 years	2.0±2.7	3.7±3.0	105
Late follow-up (5+years)	2.1±2.8	4.1±3.0	125

Mean ± standard deviation (SD);  $p < 0.0001$  for three time points postoperative vs preoperative for scores for liquids and solids

for repair and drainage ( $n=1$ ). One patient died on the tenth postoperative day following a subdural bleed, secondary to recommencement of warfarin therapy.

The operation was converted to an open procedure in seven (4.5%) patients. The reasons for conversion were: upper abdominal adhesions ( $n=2$ ), obesity ( $n=2$ ), and repair of mucosal perforation ( $n=3$ ). Five of these seven patients were in the first 20 patients in our experience with laparoscopic cardiomyotomy. Intraoperative mucosal perforation occurred in a further 12 patients, and all of these perforations were repaired laparoscopically at the primary procedure with sutures.

#### Follow-up and Outcome

Clinical outcomes were available for 143 (92.3%) patients. Actual outcome scores were available for 125 out of 155 patients at late follow-up (5 years follow-up or later). For these patients, follow-up ranged from 60 to 202 months (median, 116 months). Thirteen patients died within 5 years of the primary operation, all from causes unrelated to esophageal achalasia or the operation. One patient developed squamous cell carcinoma of the esophagus 7 years after laparoscopic myotomy, and then refused esophagectomy, dying the next year. Three refused any follow-up, and

**Table 2** Frequency of Preoperative and Postoperative Dysphagia

	Preoperative	Postoperative (1year)	Postoperative (5years)	Late follow-up (5+years)
Never	0	37	21	20
Rarely	0	0	3	3
Once/month	0	17	27	30
Few times/ week	12	27	28	32
Daily	110	23	25	26
Few times/ week and daily (%)	100%	48%	51%	52%

$p < 0.0001$  for all three postoperative time points vs preoperative

**Table 3** Frequency of Preoperative and Postoperative Odynophagia

	Preoperative	Postoperative (1year)	Postoperative (5years)	Late follow-up (5+years)
Never	20	68	52	56
Rarely	0	0	3	0
Once/month	5	13	20	29
Few times/ week	16	19	24	24
Daily	83	3	6	11
Few times/ week and daily (%)	80%	21%	29%	29%

$p < 0.0001$  for all three postoperative time points vs preoperative

four were unable to complete the questionnaire due to intellectual disability or inability to speak adequate English. Nine patients were lost to follow-up.

Table 1 shows the analog dysphagia scores for liquids and solids at various follow-up intervals. Scores were significantly improved at all postoperative time points, compared with preoperative scores. There were no significant differences in dysphagia scores at the 1 year, 5 years, and late follow-up points.

The frequency of dysphagia, odynophagia, and chest pain was significantly reduced at the follow-up time points, compared with preoperative symptoms, and there were no significant differences seen across all follow-up time points (Tables 2, 3, and 4). Table 5 shows a significant reduction in the frequency of heartburn at follow-up. Seventy-nine (63.2%) patients were able to eat an unrestricted diet at late follow-up.

Table 6 shows the postoperative Visick scores. Most patients had a sustained improvement following cardiomyotomy. One hundred thirteen (90.4%) were satisfied with their decision to undergo myotomy at late follow-up, and

**Table 4** Frequency of Preoperative and Postoperative Chest Pain

	Preoperative	Postoperative (1year)	Postoperative (5years)	Late follow-up (5+years)
Never	33	65	51	55
Rarely	0	0	4	0
Once/month	8	19	31	42
Few times/ week	42	19	16	19
Daily	41	1	3	6
Few times/ week and daily (%)	68%	19%	18%	20%

$p < 0.0001$  for all three postoperative time points vs preoperative

**Table 5** Frequency of Preoperative and Postoperative Heartburn

	Preoperative	Postoperative (1year)	Postoperative (5years)	Late follow-up (5+years)
Never	42	61	35	43
Rarely	0	0	4	0
Once/month	8	24	39*	47**
Few times/ week	33	17	20	28
Daily	39	3	6	6
Few times/ week and daily (%)	59%	19%	24%	27%

$p < 0.0001$  for all three postoperative time points vs preoperative

\* $p = 0.0218$  (5 years vs 1 year); \*\* $p = 0.0052$  (late follow-up vs 1 year)

the rate of satisfaction was similar across all follow-up time points. A good or excellent result was achieved in 73–77% of patients at 5 years and late follow-up (Table 7). Likewise, postoperative analog satisfaction scores were similar across all follow-up time points.

At late follow-up, the subjective outcome of dysphagia for solid food in patients who had had an intraoperative mucosal perforation was worse than for the other patients (mean dysphagia score 5.5 vs 3.8,  $p = 0.035$ ), and the number of patients reporting a good or excellent outcome was less (55% vs 75%).

Twenty (12.9%) patients underwent either pneumatic dilatation or reoperation or both for recurrent or persistent dysphagia. Pneumatic dilatation was used to treat 11 patients, and this was effective for six of these. The remaining five subsequently underwent a revision operation. Overall, 14 patients underwent a revision operation. The findings at revision indicated scar tissue at the gastroesophageal junction in three patients, an incomplete primary myotomy in eight, and an esophageal diverticulum in one. In addition, two patients underwent esophagectomy for end stage achalasia. There were six other patients with symptoms of recurrent dysphagia who refused either further investigations or treatment. Figure 1 shows the number of patients developing recurrent dysphagia vs the length of follow-up. Most problems presented in the first 3 years of follow-up. Overall, symptoms improved following treatment in 95% of patients with achalasia, allowing for treatment with primary laparoscopic cardiomyotomy and

any additional pneumatic dilatation or further surgery as needed. At late follow-up, the patients who required reintervention (dilatation or surgical revision) for dysphagia had higher dysphagia scores for liquids (mean 3.2 vs 1.8,  $p = 0.030$ ), and the proportion reporting a good or excellent late term outcome was less than for the patients not requiring reintervention (50% vs 77%).

Eight (6.4%) patients reported heartburn or acid regurgitation symptoms which required proton pump inhibitor medication. No revision surgery was required for gastroesophageal reflux.

**Discussion**

The development of minimally invasive surgery over recent decades has heralded significant changes in the management of achalasia. Both thoracoscopic and laparoscopic approaches are feasible, although we and others believe that the laparoscopic approach offers advantages in the primary treatment of achalasia, including superior visualization of the gastroesophageal junction, single lumen endotracheal intubation, and the ability to add an antireflux procedure.<sup>3,6</sup>

In our current study, we have evaluated the long-term clinical outcome following laparoscopic cardiomyotomy with anterior partial fundoplication for achalasia in a large group of patients. In general, our results confirm a good outcome for most patients, with generally stable clinical outcomes beyond 1-year follow-up. The frequency of symptoms of dysphagia for liquids, odynophagia, and chest pain were similar at early and late follow-up, although dysphagia for solids and heartburn did become somewhat more frequent at later follow-up, with satisfaction scores deteriorating slightly with time. Nevertheless, 73% patients were highly satisfied with their situation five or more years after laparoscopic cardiomyotomy, and 90% of patients considered that the original operation had been worthwhile.

In most other published reports of outcomes following surgical treatment of achalasia, the length of the follow-up has been relatively short, and most papers have described median or mean follow-up of less than a year.<sup>2,7–11</sup> Only four previous papers have reported longer term outcomes, two following open surgical approaches and two after laparoscopic surgery. Ortiz et al. reported 1–27 years follow-up in a series of 149 patients, with median follow-up of 6 years following open cardiomyotomy.<sup>12</sup> Fifty-three

**Table 6** Visick Scores at and at Various Follow-Up Time Points

postoperative	I	II	III	IV	V	n	I+II+III (%)
1 year	21	49	15	8	1	104	88%
5 years	17	55	15	13	5	105	83%
Late follow-up (5+ years)	19	61	22	16	7	125	82%

**Table 7** Postoperative Outcome Scores

Postoperative	Excellent	Good	Fair	Poor	<i>n</i>	Excellent or good (%)
1 year	41	40	18	5	104	78%
5 years	29	52	19	5	105	77%
Late follow-up (5+ years)	32	59	24	10	125	73%

of these patients were followed for 10 years. Their results suggested that the outcome gradually deteriorated from an initial 90% success rate at early follow-up to 75% at longer term follow-up. Csendes et al. reported similar outcomes in a series of 67 patients who were followed for 6 to 30 years (mean 16).<sup>13</sup>

More recently, Cowgill et al. reported follow-up for 33 of 47 patients who underwent laparoscopic myotomy more than 10 years earlier, with good results in the majority of patients.<sup>14</sup> In a larger laparoscopic series, Zaninotto et al.<sup>11</sup> reported 407 laparoscopic cardiomyotomies, with 97% follow-up. Median follow-up was 30 months, and 177 patients were followed for more than 5 years. An 87% 5 year actuarial success rate was reported. In our study, we obtained minimum 5 years clinical follow-up from 92% of 155 patients, and median follow-up in our series was nearly 10 years.

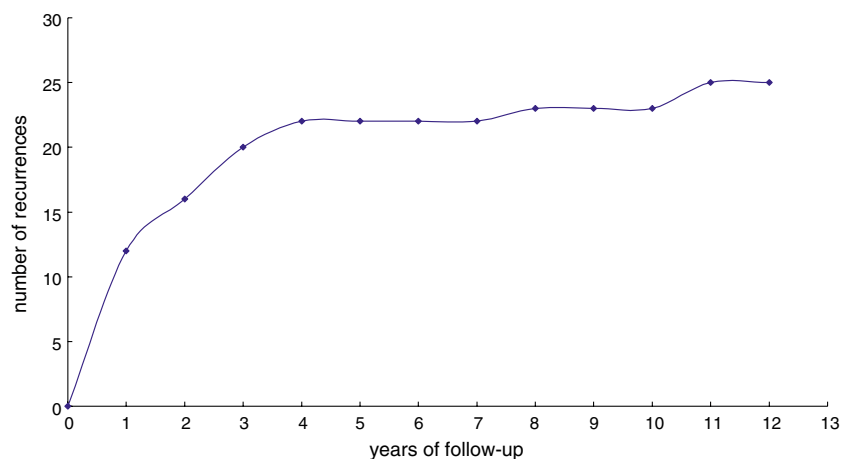
As with other reports,<sup>11–13,15</sup> we identified some deterioration in outcome at later follow-up, although most symptomatic failures occurred early. Of the 26 patients who developed recurrent dysphagia, 12 (46%) developed symptoms within 1 year of surgery, and 20 (77%) of the recurrences were within 3 years. Correspondingly, most pneumatic dilations and reoperations for dysphagia were undertaken early in the follow-up period. Possible explanations for recurrent dysphagia include: incomplete myotomy at the original operation, periesophageal inflammation, excessive scar tissue formation in the region of the previous myotomy, esophageal dilatation with sigmoid deformity, and mechanical obstruction by a fundoplication, para-

esophageal hernia, or diaphragmatic hiatal repair, as well as late occurrence of carcinoma.

Extending the myotomy below the gastroesophageal junction and onto the cardia remains a crucial part of the procedure. Mattioli et al.,<sup>16</sup> suggested that it is necessary to extend the myotomy for approximately 2 cm onto the stomach, and Oelschlager et al. have advocated extending the myotomy to 3 cm on the gastric side.<sup>17</sup> We assessed the adequacy of the myotomy with intraoperative endoscopy, and adequate opening of the gastroesophageal junction usually only required extension of the myotomy for 5 to 10 mm, and never beyond 2 cm.

It is generally accepted that achalasia is a precancerous condition, and the assumption is that retained food and saliva in the gullet can cause bacterial overgrowth and increased production of nitrosamine, leading to mucosal inflammation, dysplasia and eventually, squamous cell cancer.<sup>18–22</sup> A recent study of 2,869 patients by Zendejdel and colleagues showed that men with achalasia have a standardized incidence ratio of 8.4 and 13.1 for adenocarcinoma and squamous cell cancer, respectively, compared with the general population.<sup>23</sup> Only one patient developed esophageal squamous cell carcinoma in our series, and our data suggests that cancer development in achalasia patients remains uncommon.

Although myotomy lowers esophageal outflow resistance and improves esophageal emptying, it also increases the propensity for the development of gastroesophageal reflux. The importance of adding a fundoplication to the myotomy has, until recently, been debated, with many

**Figure 1** Cumulative number of patients with recurrent dysphagia vs length of follow-up.

opposing views advanced over the years.<sup>24,25</sup> A recent meta-analysis of 7,855 patients from 105 published papers<sup>26</sup> showed that postmyotomy reflux was less likely when a fundoplication was added (31.5% without a fundoplication vs 8.8% with;  $p=0.003$ ). In the presence of an aperistaltic, and at times dilated and tortuous esophagus, most surgeons now agree that a complete fundoplication should be avoided, and a partial fundoplication of some type is preferred.<sup>27</sup> However, the actual extent ( $180^{\circ}$  vs  $270^{\circ}$ ) and location (anterior vs posterior) is debated. Current data suggests little difference between posterior and anterior partial fundoplications. We have routinely added an anterior partial fundoplication. Apart from its antireflux effect, it might also buttress the myotomized esophageal segment. In addition, anterior fundoplication allows preservation of natural posterior attachments at the gastroesophageal junction, and only anterior hiatal dissection is required.

We have previously described a learning curve for laparoscopic cardiomyotomy for achalasia.<sup>28</sup> In this study, the duration of surgery and the risk of conversion to open surgery were influenced by the experience of the operating surgeon and the overall experience of the unit. However, the learning curve did not impact on any of the subjective clinical outcomes reported in our current study, specifically dysphagia, satisfaction with the overall surgical outcome, and the risk of subsequent surgical reintervention. For this reason, it is unlikely that the results of our current study have been influenced by a learning curve for laparoscopic cardiomyotomy.

Our current study only evaluated clinical outcomes at late follow-up. Objective evaluation, with barium swallow, esophageal manometry, pH monitoring, or endoscopy, was not routinely performed. However, resolution of clinical symptoms is the outcome patients seek, and for this reason late clinical follow-up data is still valuable. Our study has confirmed that laparoscopic cardiomyotomy with anterior partial fundoplication is a safe, effective, and durable treatment for achalasia at minimum 5 years follow-up.

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