

# Fundoplication After Laparoscopic Heller Myotomy for Esophageal Achalasia: What Type?

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Received: 12 January 2010 / Accepted: 23 February 2010 / Published online: 19 March 2010  
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**Abstract** Because of the high success rate of minimally invasive surgery, a radical shift in the treatment algorithm of esophageal achalasia has occurred. Today, a laparoscopic Heller myotomy is the preferred treatment modality for achalasia. This remarkable change is due to the recognition by gastroenterologists and patients that a laparoscopic Heller myotomy gives better and more durable results than pneumatic dilatation and intrasphincteric injection of botulinum toxin injection, while it is associated to a short hospital stay and a fast recovery time. While there is agreement about the need of a fundoplication in conjunction to the myotomy, some questions still remain about the type of fundoplication: Should the fundoplication be total or partial, and in case a partial fundoplication is chosen, should it be anterior or posterior? The following review describes the data present in the literature in order to identify the best procedure that can achieve prevention or control of gastroesophageal reflux after a myotomy without impairing esophageal emptying.

**Keywords** Esophageal achalasia · Laparoscopic Heller myotomy · Laparoscopic fundoplication

Esophageal achalasia is a primary esophageal motility disorder of unknown origin characterized by lack of esophageal peristalsis and inability of the lower esophageal sphincter (LES) to relax properly in response to swallowing. The goal of treatment is to relieve the functional obstruction caused by the LES, therefore allowing emptying of food into the stomach by gravity. A laparoscopic Heller myotomy is considered today the most effective and long-lasting treatment modality to achieve this goal (Table 1). However, a myotomy may cause reflux of gastric contents into the aperistaltic esophagus, with risk of developing complications such as strictures, Barrett's esophagus, and even adenocarcinoma.<sup>11–14</sup> While there is agreement about the need for a fundoplication in conjunction with the myotomy, there is no consensus about the type of fundoplication that should be performed.

The following review describes the data present in the literature in order to identify the best procedure that allows prevention or control of gastroesophageal reflux after a myotomy, without impairing esophageal emptying.

## The Evolution of Minimally Invasive Surgery for Achalasia

In 1992, we described our initial experience with a thoracoscopic Heller myotomy.<sup>15</sup> We performed a left thoracoscopic myotomy (with the guidance of intraoperative endoscopy), which extended for only 5 mm onto the gastric wall. The rationale for the short myotomy was to relieve dysphagia while trying to avoid postoperative reflux. The long-term follow-up in the first 30 patients who underwent a left thoracoscopic Heller myotomy confirmed the excellent outcome of the initial report.<sup>16</sup> Almost 90% of patients had relief of dysphagia, the hospital stay was short, the postoperative discomfort was minimal, and the recovery was fast. However, some shortcomings of the thoracoscopic technique soon became apparent, particularly a very high incidence of postoperative reflux. We found, in fact, that a thoracoscopic myotomy was associated to reflux in 60% of patients studied postoperatively by pH monitoring. In

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**Table 1** Outcomes of Laparoscopic Heller Myotomy

| Author/year                                 | Type of study | Samples | Dysphagia relief (%) | Postoperative gastroesophageal reflux (%) | Follow-up  | Note                                                               | Oxford Center for Evidence-Based Medicine Levels of Evidence |
|---------------------------------------------|---------------|---------|----------------------|-------------------------------------------|------------|--------------------------------------------------------------------|--------------------------------------------------------------|
| <b>Meta-analysis</b>                        |               |         |                      |                                           |            |                                                                    |                                                              |
| Wang et al. 2009 <sup>1</sup>               | Meta-analysis | NR      | 82–84                | NR                                        | NR         | LHM superior to pneumatic dilatation and botulinum toxin injection | 1                                                            |
| Campos et al. 2009 <sup>2</sup>             | Meta-analysis | 3,086   | 89                   | 15                                        | 35 months  | LHM superior to pneumatic dilatation and botulinum toxin injection | 2                                                            |
| <b>Studies with follow-up &gt;10 years</b>  |               |         |                      |                                           |            |                                                                    |                                                              |
| Cowgill et al. 2010 <sup>3</sup>            | Case series   | 47      | 92                   | NR                                        | 10.6 years | All patients over 10 years of follow-up                            | 4                                                            |
| Jeansonne et al. 2007 <sup>4</sup>          | Case series   | 17      | 47                   | NR                                        | 11.2 years | All patients over 10 years of follow-up                            | 4                                                            |
| <b>Studies with follow-up &gt;5 years</b>   |               |         |                      |                                           |            |                                                                    |                                                              |
| Kilic et al. 2009 <sup>5</sup>              | Case series   | 46      | 80                   | NR                                        | 6.4 years  | All patients over 5 years of follow-up                             | 4                                                            |
| <b>Studies with <math>n &gt; 100</math></b> |               |         |                      |                                           |            |                                                                    |                                                              |
| Patti et al. 2001 <sup>6</sup>              | Case series   | 102     | 89                   | NR                                        | 25 months  | Dor fundoplication                                                 | 4                                                            |
| Zaninotto et al. 2008 <sup>7</sup>          | Case series   | 400     | 87                   | 6                                         | 30 months  | Dor fundoplication. 45% followed up >60 months                     | 4                                                            |
| Wright et al. 2007 <sup>8</sup>             | Case series   | 115     | 90                   | 19 (Dor)/50 (Toupet)                      | 45 months  | Dor or Toupet fundoplication                                       | 4                                                            |
| Khajanchee et al. 2005 <sup>9</sup>         | Case series   | 121     | 84                   | 33                                        | 9 months   | Toupet fundoplication                                              | 4                                                            |
| Perrone et al. 2004 <sup>10</sup>           | Case series   | 100     | 96                   | NR                                        | 26 months  | Toupet fundoplication                                              | 4                                                            |

NR not reported, *LHM* laparoscopic Heller myotomy

addition, we were unable to correct the reflux, which was already present in some patients secondary to pneumatic dilatation. Other centers also documented a high incidence of postoperative reflux after thoracoscopic myotomy.<sup>17,18</sup>

Other studies showed that a laparoscopic myotomy alone was also associated to a high incidence of reflux.<sup>19,20</sup> Kjellin and colleagues found abnormal reflux by pH monitoring in eight of 14 (57%) patients after laparoscopic myotomy without fundoplication.<sup>19</sup> Similarly, Burpee and colleagues documented reflux (by pH monitoring or endoscopy) in 18 of 30 patients (60%) after laparoscopic Heller myotomy without fundoplication.<sup>20</sup> The findings of these retrospective studies were confirmed by two prospective trials, which showed that a myotomy alone is associated to a high incidence of reflux, while a fundoplication decreased significantly this problem.<sup>21,22</sup> In 2003, Falkenback and colleagues reported the results of a prospective randomized trial comparing myotomy alone versus myotomy and Nissen fundoplication.<sup>21</sup> Postoperative reflux was present in 25% of patients who had a

myotomy and fundoplication but in 100% of patients who had a myotomy alone. Twenty percent of the patients in the latter group developed Barrett's esophagus. In 2004, Richards and colleagues reported the results of a prospective randomized trial comparing laparoscopic myotomy alone versus laparoscopic myotomy and Dor fundoplication.<sup>22</sup> Postoperative ambulatory pH monitoring showed reflux in 48% of patients after myotomy alone but in only 9% of patients when a Dor fundoplication was added to the myotomy. The incidence and the score of postoperative dysphagia were similar in the two groups, suggesting that the addition of a partial fundoplication did not impair esophageal emptying (Table 2).

### Which Fundoplication? Partial Versus Total Fundoplication

It has been shown that a laparoscopic total (360°) fundoplication is the procedure of choice in patients with

**Table 2** Outcome of Laparoscopic Heller Myotomy Alone or Laparoscopic Heller Myotomy and Fundoplication

| Author/year                               | Type of study | Samples | Dysphagia relief (%) | Postoperative gastroesophageal reflux (%) | Follow-up | Note                  | Oxford Center for Evidence-Based Medicine Levels of Evidence |
|-------------------------------------------|---------------|---------|----------------------|-------------------------------------------|-----------|-----------------------|--------------------------------------------------------------|
| Campos et al. 2009 <sup>2</sup> LHM       | Meta-analysis | 579     | 90                   | 31                                        | NR        |                       | 2                                                            |
| LHMF                                      |               | 2,507   | 90                   | 9                                         |           |                       |                                                              |
| Richards et al. 2004 <sup>22</sup> LHM    | RCT           | 21      | NR                   | 48                                        | 6 months  | Dor fundoplication    | 1                                                            |
| LHMF                                      |               | 22      | NR                   | 9                                         |           |                       |                                                              |
| Falkenback, et al. 2003 <sup>21</sup> LHM | RCT           | 10      | 70                   | 13                                        | 8 years   | Nissen fundoplication | 1                                                            |
| LHMF                                      |               | 10      | 70                   | 0.1                                       |           |                       |                                                              |

NR not reported, RCT randomized clinical trial, LHM laparoscopic Heller myotomy, LHMF laparoscopic Heller myotomy+fundoplication

gastroesophageal reflux disease. When compared to a partial fundoplication, a total fundoplication determines a better control of reflux without a higher incidence of postoperative dysphagia, even when esophageal peristalsis is weak.<sup>23</sup> In esophageal achalasia, however, the pump action of the esophageal body is completely missed, as there is no peristalsis. Therefore, a total fundoplication might determine too much of a resistance at the level of the gastroesophageal junction, impeding the emptying of food from the esophagus into the stomach by gravity and eventually causing persistent or recurrent dysphagia. Albeit some groups still claim good results adding a total fundoplication after a myotomy<sup>21,24,25</sup> (Fig. 1), others have abandoned this procedure and switched to a partial fundoplication. This switch was based on the results of long-term studies that showed that esophageal decompensation and recurrence of symptoms eventually occur in most patients.<sup>26–30</sup> For instance, Duranceau and colleagues initially reported excellent results with a Heller myotomy and total fundoplication.<sup>28</sup> Ten years later, however, they noted that symptoms had recurred in 14 of 17 patients (82%), five of whom required a second operation.<sup>29</sup> They felt that a total fundoplication determines over time a progressive increase in esophageal retention with poor emptying and recurrence of symptoms. They were able to avoid this problem by performing a partial fundoplication.<sup>30</sup> These findings have been recently confirmed by a prospective and randomized trial comparing a Dor to Nissen fundoplication after Heller myotomy.<sup>31</sup> While the incidence of clinical or instrumental reflux was low and similar in the two groups, 15% of patients after Nissen fundoplication had dysphagia at a 5-year follow-up, as compared to only 2.8% after Dor fundoplication.

Based on this evidence, it is reasonable to state that a laparoscopic Heller myotomy with partial fundoplication

should be considered today the procedure of choice for esophageal achalasia, as it attains the best balance between relief of dysphagia and prevention of reflux (Table 3).

### Partial Fundoplication: Anterior Versus Posterior

There are no published prospective randomized trials comparing a partial posterior (Toupet, Fig. 2) versus an anterior (Dor, Fig. 3) fundoplication in association to a Heller myotomy in patients with achalasia. Some groups

**Figure 1** Heller myotomy and Nissen (total) fundoplication.

**Table 3** Swallowing Status and Incidence of Postoperative Reflux After Laparoscopic Heller Myotomy and Total Fundoplication and Laparoscopic Heller Myotomy and Partial Fundoplication

| Author/year                          | Type of study | Samples | Dysphagia relief (%) | Postoperative GERD (%) | Follow-up  | Note                                           | Oxford Center for Evidence-Based Medicine Levels of Evidence |
|--------------------------------------|---------------|---------|----------------------|------------------------|------------|------------------------------------------------|--------------------------------------------------------------|
| Rebecchi et al. 2008 <sup>31</sup>   | RCT           | 67      | 85                   | 0                      | 125 months |                                                | 1                                                            |
| LHMT                                 |               | 71      | 97                   | 3                      |            | Dor fundoplication                             |                                                              |
| Studies with LHMT                    |               |         |                      |                        |            |                                                |                                                              |
| Falkenback et al. 2003 <sup>21</sup> | RCT           | 10      | 70                   | 0.1                    | 8 years    |                                                | 1                                                            |
| Frantzides et al. 2004 <sup>24</sup> | Case series   | 48      | 92                   | 2                      | 3 years    |                                                | 4                                                            |
| Rossetti et al. 2005 <sup>25</sup>   | Case series   | 195     | 98                   | 0                      | 83 months  |                                                | 4                                                            |
| Donahue et al. 2002 <sup>27</sup>    | Case series   |         |                      |                        |            |                                                | 4                                                            |
| Studies with LHMP                    |               |         |                      |                        |            |                                                |                                                              |
| Patti et al. 2001 <sup>6</sup>       | Case series   | 102     | 89                   | NR                     | 25 months  | Dor fundoplication                             | 4                                                            |
| Zaninotto et al. 2008 <sup>7</sup>   | Case series   | 400     | 87                   | 6                      | 30 months  | Dor fundoplication. 45% followed up >60 months | 4                                                            |
| Wright et al. 2007 <sup>8</sup>      | Case series   | 115     | 90                   | 19 (Dor)/50 (Toupet)   | 45 months  | Dor or Toupet fundoplication                   | 4                                                            |
| Khajanchee et al. 2005 <sup>9</sup>  | Case series   | 121     | 84                   | 33                     | 9 months   | Toupet fundoplication                          | 4                                                            |
| Perrone et al. 2004 <sup>10</sup>    | Case series   | 100     | 96                   | NR                     | 26 months  | Toupet fundoplication                          | 4                                                            |

NR not reported, RCT randomized clinical trial, LHMT laparoscopic Heller myotomy+total fundoplication, LHMP laparoscopic Heller myotomy+partial fundoplication

**Figure 2** Heller myotomy and Toupet (partial anterior) fundoplication.**Figure 3** Heller myotomy and Dor (partial posterior) fundoplication.

**Table 4** Swallowing Status and Incidence of Postoperative Reflux After Laparoscopic Heller Myotomy and Toupet and Laparoscopic Heller Myotomy and Dor Fundoplication

| Author/year                         | Type of study | Samples | Dysphagia relief (%) | Postoperative gastroesophageal reflux (%) | Follow-up | Note                                           | Oxford Center for Evidence-Based Medicine Levels of Evidence |
|-------------------------------------|---------------|---------|----------------------|-------------------------------------------|-----------|------------------------------------------------|--------------------------------------------------------------|
| Patti et al. 2001 <sup>6</sup>      | Case series   | 102     | 89                   | NR                                        | 25 months | Dor fundoplication                             | 4                                                            |
| Zaninotto et al. 2008 <sup>7</sup>  | Case series   | 400     | 87                   | 6                                         | 30 months | Dor fundoplication. 45% followed up >60 months | 4                                                            |
| Wright et al. 2007 <sup>8</sup>     | Case series   | 115     | 90/90                | 19 (Dor)/50 (Toupet)                      | 45 months | Dor or Toupet fundoplication                   | 4                                                            |
| Khajanchee et al. 2005 <sup>9</sup> | Case series   | 121     | 84                   | 33                                        | 9 months  | Toupet fundoplication                          | 4                                                            |
| Perrone et al. 2004 <sup>10</sup>   | Case series   | 100     | 96                   | NR                                        | 26 months | Toupet fundoplication                          | 4                                                            |

feel that a posterior fundoplication is better procedure as it keeps the edges of the myotomy separated, and it may be a more effective antireflux operation.<sup>32–34</sup> Others, however, prefer a Dor fundoplication as it is simpler to perform (no need for posterior dissection), and it adds the advantage of covering the exposed mucosa<sup>7,22,35–38</sup> (Table 4).

SAGES is presently conducting a prospective, randomized, and multicenter study comparing laparoscopic Heller myotomy and Dor to laparoscopic Heller myotomy and Toupet fundoplication. The technique of the two procedures has been standardized.<sup>9,39</sup> The end point of the study will be the incidence of postoperative reflux as measured by pH monitoring and relief of dysphagia.

Our philosophy during the last 15 years has been to perform a laparoscopic Heller myotomy and Dor fundoplication.<sup>39</sup> The myotomy is about 9 cm in length and extends for about 2–2.5 cm onto the gastric wall. Intraoperative endoscopy is helpful at the beginning of a surgeon's experience to gauge the extent of the myotomy onto the gastric wall in respect to the squamous-columnar junction, as seen by endoscopy. However, once the surgeon has gained experience with the anatomy from a laparoscopic perspective, it can be omitted. After the short gastric vessels are divided, an anterior 180° fundoplication (Dor) is performed. There are two rows of sutures, one right and one left. The left row has three stitches: The first stitch incorporates the stomach, the esophagus, and the left pillar of the crus. The second and the third stitch incorporate only the stomach and the esophageal wall. Subsequently, the fundus is folded over the exposed mucosa, so that the greater curvature of the stomach is next to right pillar of the crus. Similar to the left the row, the right row has three stitches, placed between the fundus of the stomach and the right pillar of the crus. Finally, two or three additional stitches are placed between the superior aspect of the

fundoplication and the anterior rim of the esophageal hiatus (Fig. 3).

## Conclusions

The last decade has witnessed a radical change in the treatment of esophageal achalasia due to the adoption of minimally invasive techniques. Because of the high success rate of a laparoscopic Heller, surgery has in fact become the preferred treatment modality of most gastroenterologists and other referring physicians. During the last 5 years, we have noted a 15-fold increase in the number of patients referred for surgery every year. In addition, the gradual increase in the number of referred patients has been paralleled by an increase in the number of patients referred without previous treatment.<sup>40</sup> This remarkable change has followed documentation that laparoscopic myotomy outperforms balloon dilatation and botulinum toxin injection.<sup>41,42</sup>

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