# Anterior Partial Fundoplications: Indications and Technique

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## Indications

Worldwide, the most common operation performed for the treatment of gastro-esophageal reflux disease remains the Nissen fundoplication. However, in some patients this procedure is followed by troublesome side effects, such as dysphagia, abdominal bloating, inability to belch, flatulence etc, and these can lead to the perception of a less than satisfactory outcome. Modifying a Nissen to a partial fundoplication is a strategy that can reduce the risk of these side effects. There are two competing approaches for construction of a partial fundoplication—anterior vs. posterior. When compared to Nissen fundoplication longer term follow-up within randomized controlled trials has demonstrated advantages for both of these approaches [1], although probably the lowest risk of side effects follows anterior partial fundoplication variants [2]. The placement of the gastric fundus behind the distal esophagus when constructing either a posterior partial or a Nissen fundoplication lifts the distal esophagus forward and angulates the gastro-esophageal junction which might contribute to post-fundoplication dysphagia, as well as other gas-related side effects. With anterior partial fundoplication the gastric fundus is placed in front of the esophagus, and the esophagus is not lifted forward or angulated, resulting in a more anatomically correct position.

Worldwide, the Dor fundoplication, a variant of the anterior partial fundoplication, is often added following cardiomyotomy for achalasia, in an attempt to minimize the risk of reflux following this procedure. With cardiomyotomy the lower esophageal sphincter is fully divided, and the body of the esophagus in patients with achalasia also lacks peristalsis. This is a highly refluxogenic situation. It is widely agreed that the use of an anterior partial fundoplication is appropriate in these patients, and the reported clinical outcomes are generally good, with good antireflux efficacy. If an anterior fundoplication is effective in this difficult situation, it seems like it would make sense to consider wider application in the context of surgery for reflux, as an alternative to a Nissen fundoplication for example, which can minimize side effects but still achieve reflux control, would be desirable. Examples of high-risk situations where a partial fundoplication is already more widely used include patients with reflux and an aperistaltic esophagus, as well as difficult clinical situations such as reflux with atypical throat symptoms, and scenarios where the surgeon wants to control reflux but avoid adding any new post-fundoplication problems (emotionally "challenging" patients). Using an anterior partial fundoplication as a form gastropexy in patients undergoing repair of a large hiatus hernia, in whom the presenting symptoms are due to mechanical problems from the hernia, rather than gastro-esophageal reflux, also makes sense.

In the past, the absence of good long-term outcome studies led many surgeons to apply a selective approach to the use of partial fundoplications for the surgical treatment of gastro-esophageal reflux, with the Nissen fundoplication widely accepted as the "gold standard" and the expectation that partial wraps would have a compromised success rate. However, long-term outcome data at 10 or more years follow-up is now available, and this suggests overall success rates for partial wraps which are equivalent to Nissen fundoplication [3, 4]. This late follow-up data shows similar patient satisfaction with the overall outcome, but with a tradeoff between the risk of recurrent reflux versus the risk of side effects. For anterior partial fundoplication, the supporting data is more robust for anterior 180° partial fundoplication [3, 5], than for anterior 90° partial fundoplication with some studies suggesting a higher rate of recurrent reflux following the latter approach [6, 7].

Hence, in clinical practice, there is now sufficient data to support the application of an anterior 180° partial fundoplication in most patients presenting for antireflux surgery. In patients with reflux and normal or relatively normal esopha-

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geal motility a discussion about the risks of side effects versus the risk of recurrent reflux following anterior 180° partial versus Nissen fundoplication is appropriate, and in my practice patients are encouraged to choose the type of fundoplication which best fits their expectations. Approximately 60 % choose an anterior 180° partial fundoplication. In addition, an anterior 180° partial fundoplication is always used for patients in whom the side effect profile needs to be minimized (scenarios described above). In patients with a large hiatus hernia, but no reflux symptoms, repair of the hernia rather than controlling reflux becomes the aim of surgery, I construct an anterior 90° partial fundoplication primarily to improve anchorage of the stomach within the abdomen, as minimization of the risk of side effects is particularly important in these patients.

## Surgical Technique

When constructing an anterior partial fundoplication, the key steps are to reduce and repair any hiatal hernia, stabilize and maintain an adequate length of intra-abdominal esophagus, and create a stable flap valve by folding and anchoring the anterior fundus loosely across the front of the esophagus. Stabilization of the partial fundoplication requires anchorage to the more rigid diaphragmatic hiatus, and this new anatomical relationship needs to be stable for the long-term. To ensure this, adequately large bites of tissue must be taken with each suture—stomach, esophagus and hiatal rim. As the laparoscope magnifies the view, the tendency to be cautious and take superficial bites of all structures must be resisted. Full thickness sutures of the esophageal and gastric walls are rarely a problem, and adequate sutures ensure adequate anchorage of the fundoplication.

### Hiatal Dissection and Repair

Laparoscopic port placement is as for any other laparoscopic antireflux procedure. Four ports and a Nathanson liver retractor are used for surgical access. Two 11 mm ports are placed, one supra-umbilically for the laparoscope, and the other just below the left costal margin in the mid-clavicular line as the main working port. Two 5 mm ports are also placed, one just below the right costal margin in the mid-clavicular line, and the other in the left flank. A separate 5 mm subxiphoid incision is used for the Nathanson liver retractor.

The hiatus is dissected to expose the hiatal rim and the intra-abdominal esophagus, and any associated hiatal hernia is fully reduced. My preference is to use a blunt dissection technique, supplemented by diathermy hook dissection as required. If dissection is maintained in the correct plane and the fascial coverings over the hiatal rim are preserved so that muscle fibers are not exposed, then dissection is virtually bloodless. Troublesome bleeding indicates dissection in the wrong plane. If a very large hiatus hernia is present, the hiatal rim must be dissected first and the hernia sac removed fully from the chest before progressing to esophageal dissection.

The next step is dissection of the esophagus and the posterior hiatus. Care must be taken when dissecting behind the esophagus, as blind dissection or enthusiastic use of energy sources in this area can lead to perforation of the esophagus. The esophagus is encircled with a tape and retracted anteriorly and to the left, and dissection continues until both hiatal pillars are well displayed with the left pillar visible from behind the esophagus. The hiatus is then repaired posterior to the esophagus with interrupted non-absorbable sutures. Usually 1-3 sutures are sufficient. Care should be taken to avoid excessively narrowing the hiatus as this can cause post-operative dysphagia.

### Construction of an Anterior 180° Partial Fundoplication

When constructing an anterior 180° partial fundoplication, the aim is to create a stable flap valve, and anchor the distal esophagus within the abdomen. This is done by suturing the gastric fundus to the distal esophagus and the right side of the hiatal rim. The short gastric blood vessels do not need to be divided. Before suturing, the correct piece of stomach for the construction of the partial wrap must be carefully selected (Figs. 11.1 and 11.2). When doing this, the assistant uses a grasper to retract the pericardial fat pad downwards into abdomen. This ensures that the gastro-esophageal junction and at least 4–5 cm of distal esophagus are fully reduced into

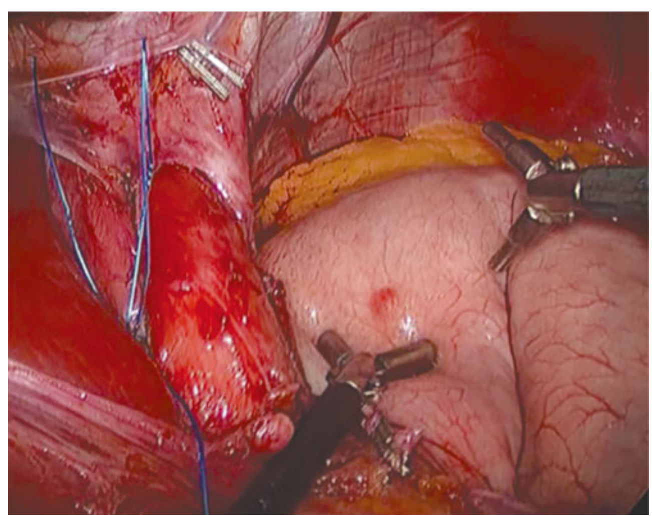

**Fig. 11.1** Selection of the correct piece of anterior fundus for anterior 180° partial fundoplication. The assistant pulls the gastro-esophageal junction downwards. The correct piece of fundus is usually closer to the gastro-esophageal junction than the greater curve aspect of the fundus

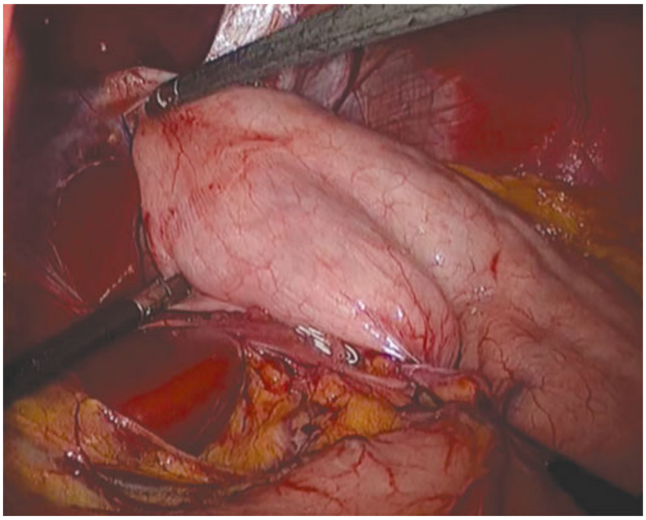

**Fig. 11.2** The correct piece of anterior fundus is selected when it sits loosely across the anterior esophagus and hiatus

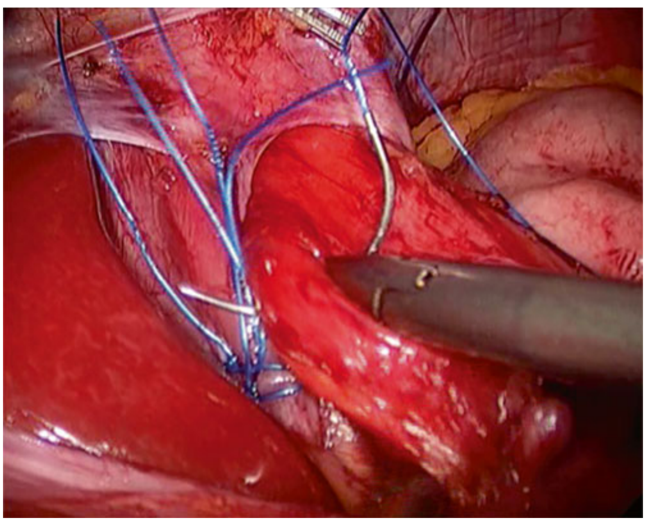

**Fig. 11.3** The first suture includes the postero-lateral wall of the distal esophagus at least 2 cm proximal to the gastro-esophageal junction. To stabilize the anatomy a generous depth of tissue is included in this suture

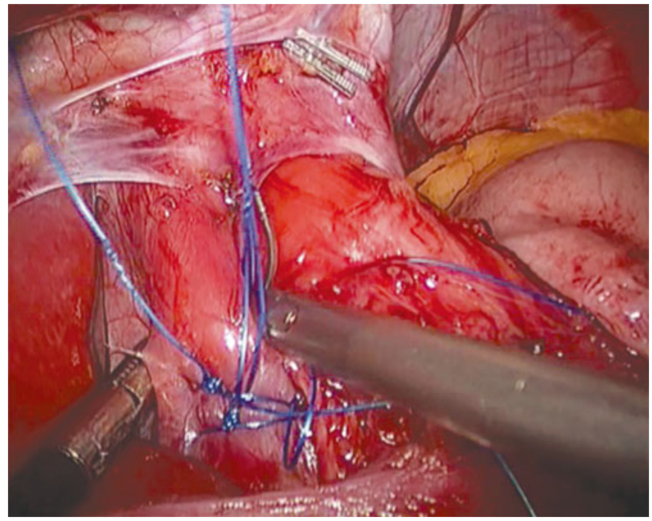

**Fig. 11.4** The first suture also includes a generous bite of the right hiatal pillar at the level of the most anterior hiatal repair suture

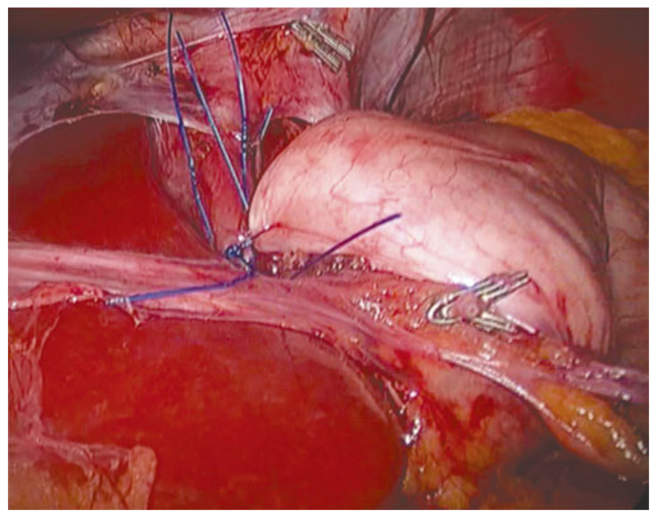

**Fig. 11.5** The completed first suture anchors the anterior fundus to the right postero-lateral esophagus and the right hiatal pillar. When correctly placed this suture sets and guides the placement of the remaining sutures

the abdomen. Next, the upper part of the anterior gastric fundus is folded across the esophagus and manipulated until it sits loosely across the front of the esophagus and hiatus. This entails using the fundus approximately 1/4 to 1/3 of the way from the gastro-esophageal junction to the greater curve of the fundus, rather than the more lateral fundus, which is adjacent to insertion of the short gastric vessels.

The first fundoplication suture is critical as correct placement sets up the rest of the operation and ensures the anterior partial fundoplication is correctly constructed. This suture is placed through the gastric fundus, then the postero-lateral wall (7–8 o'clock position) of the distal esophagus at least 2 cm proximal to the gastro-esophageal junction (Fig. 11.3), and finally through the right hiatal pillar at approximately the same level as the most anterior hiatal repair suture (Figs. 11.4 and 11.5). Generous bites of the gastric and esophageal walls and the hiatal rim are included to ensure a stable fundoplication, and near full thickness bites (and perhaps occasionally actual full thickness bites) stabilize the anatomy long-term.

The second and third sutures are also placed through the gastric fundus, the distal esophagus, and the right hiatal pillar, with the second suture placed 5 mm above the first, and the third suture placed a further 5 mm proximally (Fig. 11.6). Two "crown" sutures are then placed to anchor the fundus to

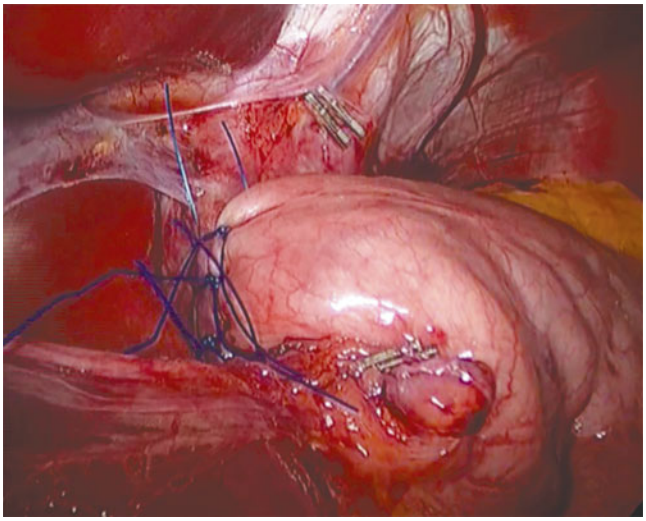

**Fig. 11.6** The first three sutures all incorporate the fundus, the esophagus and the right hiatal pillar. They are placed approximately 5 mm apart and anchor the fundus loosely across the esophagus

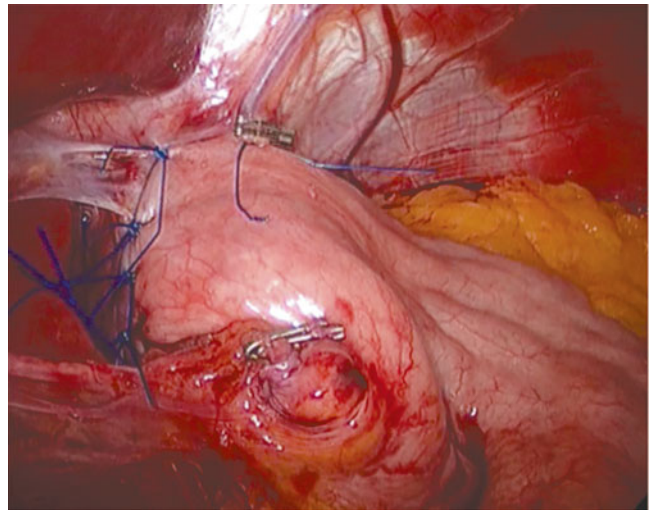

**Fig. 11.8** The completed anterior 180° partial fundoplication

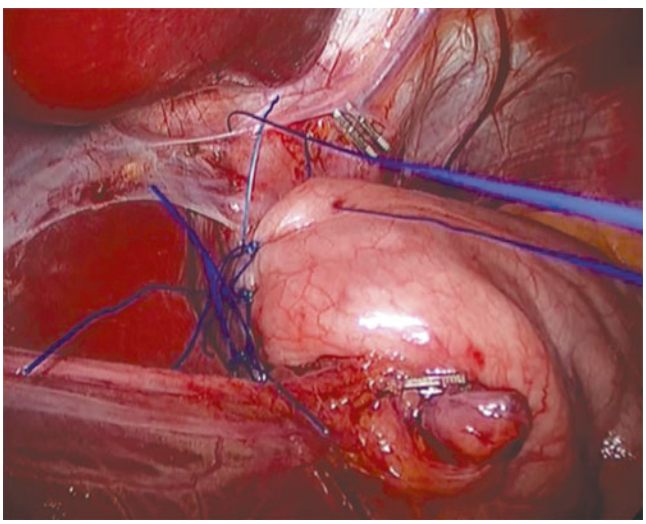

**Fig. 11.7** The first "crown" suture attaches the fundus to the hiatal rim at the 11 o'clock position

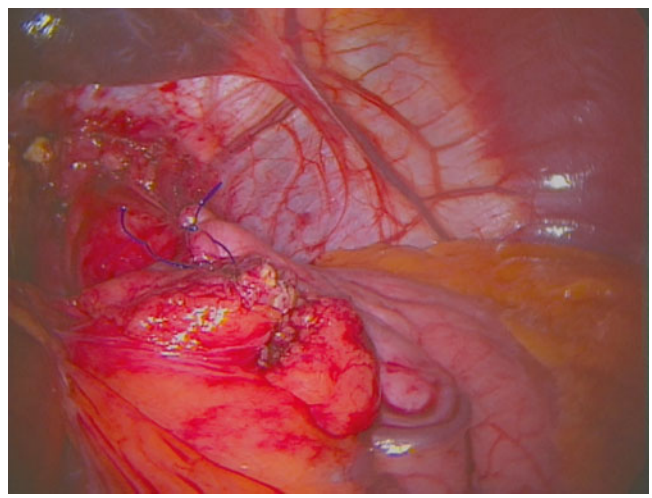

**Fig. 11.9** When constructing an anterior 90° partial fundoplication, two sutures are placed to close the angle of His. The highest of these sutures incorporates the left side of the esophagus, the fundus and the left hiatal pillar

the diaphragm, closing the space across the anterior hiatus. The first of these sutures attaches the fundus to the hiatal rim at the 11 o'clock position (Fig. 11.7), and the second at the 1–2 o'clock position (Fig. 11.8). No sutures are needed on the left lateral side of the esophagus.

## Construction of an Anterior 90° Partial Fundoplication

A somewhat different approach is used when constructing an anterior 90° partial fundoplication, although the aim is still to create a stable flap valve by anchoring the distal esophagus within the abdomen, and then the gastric fundus to the distal esophagus. However, the fundus is not sutured to the right hiatal rim during this procedure. The assistant still retracts the pericardial fat pad downwards into abdomen to reduce the gastro-esophageal junction and a length of distal esophagus into the abdomen.

The first suture attaches the right postero-lateral esophagus (7–8 o'clock position), at least 2 cm proximal to the gastro-esophageal junction, to the right hiatal pillar at the level of the most anterior hiatal repair suture. This attaches the esophagus to the hiatal rim—i.e., and esophagopexy. The next two sutures close the angle of His (Fig. 11.9). The gastric fundus immediately adjacent to left side of the distal esophagus is sutured to the distal esophagus. The first of these sutures attaches the left side of the esophagus (3 o'clock position,

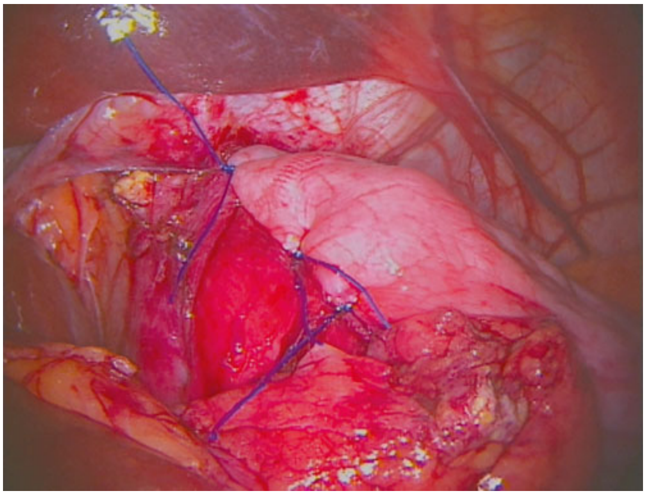

**Fig. 11.10** After closing the angle of His, the gastric fundus is sutured to the anterior esophagus and to the anterior rim of the esophageal hiatus (11 o'clock position)

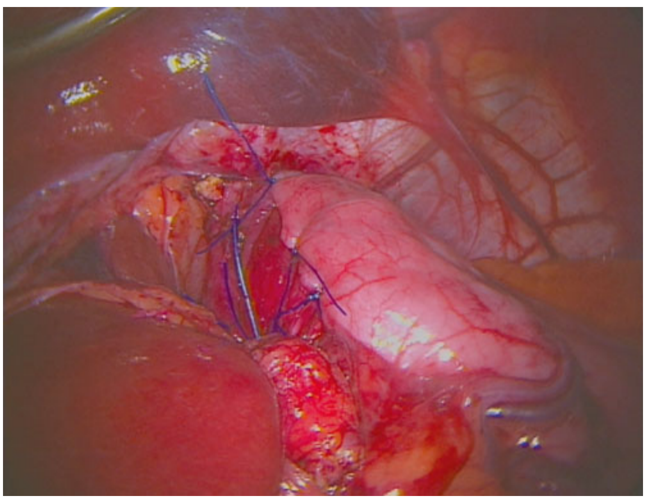

**Fig. 11.11** The completed anterior 90° partial fundoplication

1–2 cm above the gastro-esophageal junction) to the gastric fundus. The second suture attaches the left side of the esophagus to the gastric fundus 1 cm proximal to the first suture, and also includes the left hiatal pillar at the 3 o'clock position. This creates a second point of anchorage to the hiatal rim.

Next the gastric fundus is rolled over the left anterior esophagus so that it sits loosely in place covering the left anterolateral aspect of the esophagus. The apex of this piece of fundus is sutured to the anterior esophagus (11–12 o'clock position) and to the anterior rim of the esophageal hiatus, at the 11 o'clock position (just to the right of the midline) (Fig. 11.10). This creates a third point of anchorage between the esophagus and the hiatal rim. The final suture is between the gastric fundus and the anterior esophagus 1 cm below the previous suture (Fig. 11.11). Again, generous bites of the gastric and esophageal walls, as well as the hiatal rim are needed to stabilize the fundoplication.

## Results

The results from clinical trials as well as long-term follow-up of large prospective case series support the use of anterior partial fundoplication for the surgical treatment of gastroesophageal reflux. Six randomized controlled trials have compared Nissen vs. anterior partial fundoplication. The first trial (from my unit) enrolled 107 patients to Nissen vs. anterior 180° partial fundoplication [5, 8, 9]. Early outcomes were reported in 1999, and at 6 months follow-up patients who underwent anterior 180° partial fundoplication had less dysphagia, were less troubled by flatus, were more likely to be able to belch normally and reported a better overall outcome [8]. A subsequent report of 5-year follow-up outcomes confirmed the early results [9], with significantly less dysphagia, less abdominal bloating, better preservation of belching, and a greater proportion of patients reporting a good overall outcome 5 years after the anterior 180° fundoplication, although this was offset by slightly better reflux control following Nissen fundoplication. At 10 years follow-up, however, the clinical outcomes for both procedures converged, and no clinically or statistically significant differences were demonstrable for Nissen vs. anterior 180° fundoplication at late follow-up [5].

Baigrie et al. [10] reported 2-year outcomes from a similar trial which enrolled 161 patients to Nissen vs. anterior 180° partial fundoplication, and showed equivalent control of reflux symptoms, and less dysphagia following anterior 180° partial fundoplication, although in this study re-operation for recurrent reflux was more common after anterior partial fundoplication. Cao et al. [11] reported 5-year outcomes from another trial that included 100 patients. Reflux control was similar for anterior 180° partial vs. Nissen fundoplication, and flatulence was less common after anterior fundoplication. Raue et al. [12] reported equivalent outcomes at 18 months follow-up in a smaller trial of 64 patients.

Two randomized trials, both coordinated from my unit, have compared laparoscopic anterior 90° partial vs. Nissen fundoplication. In the first, 112 patients were enrolled in a multicenter Australia and New Zealand trial [13]. Side effects were less common following anterior 90° fundoplication, but offset by a slightly higher incidence of recurrent reflux at early (6 months) follow-up. At 5 years outcomes were similar for side effects and overall satisfaction with the outcome, although reflux was more common after anterior 90° partial fundoplication [6]. Similar short-term outcomes, with less side effects, offset by more reflux, were reported from a parallel single-center randomized trial that enrolled 79 patients [14].

Two other randomized trials have compared anterior vs. posterior partial fundoplication. Hagedorn et al. [15] enrolled 95 patients to posterior (Toupet) vs. anterior 120° partial fundoplication, and showed better reflux control, but more side effects following posterior fundoplication. However, the clinical and objective outcomes following anterior 120°

fundoplication in this trial were significantly worse than the outcomes from other randomized studies, with the average 24 h pH monitoring acid (pH < 4) exposure time being 5.6 % following anterior 120° fundoplication. In other studies this figure has been approximately 2.5 % [8, 13], suggesting a problem with the surgical technique used for anterior 120° fundoplication in Hagedorn et al.'s study. Khan et al. [16] recently reported 6-month follow-up from a trial which enrolled 103 patients to anterior 180° vs. posterior partial fundoplication. Reflux control was also better after posterior fundoplication, but offset by more side effects.

Overall, the results from these randomized trials suggest that anterior partial fundoplication achieves satisfactory control of reflux, a reduced incidence of post-fundoplication dysphagia and other side effects, and a good overall clinical outcome. However, the reduced incidence of side effects is offset to some extent by a higher risk of recurrent reflux. More recently, we reported a much larger series of 548 patients who underwent anterior 180° partial fundoplication and were followed prospectively for up to 16 years [3]. Approximately 90 % of these patients were highly satisfied with their clinical outcome at very late follow-up, and these results compare favorably with late outcomes following Nissen fundoplication. Data from all these studies confirms that anterior partial fundoplication offers a valid alternative to other types of fundoplication and minimizes the risks of side effects. There is now sufficient data to support its acceptability as a surgical treatment of gastro-esophageal reflux.

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