

# Anterior 180° Partial Fundoplication—How I Do It

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**Abstract** Laparoscopic Nissen fundoplication is the standard operation for the surgical control of gastro-oesophageal reflux in many centres. However, in some patients, it can be followed by troublesome side effects, and to minimise the risk of these, partial fundoplications have been recommended. One approach is to construct an anterior 180° partial fundoplication. Randomised trials and a large outcome study have confirmed that in most patients, this approach achieves effective reflux control, as well as a reduced incidence of side effects. In this paper, we describe our approach to this procedure. The procedure entails full dissection of the oesophageal hiatus, hiatal repair with posteriorly placed sutures and then construction of an anterior 180° partial fundoplication using three sutures to attach the anterior gastric fundus to the oesophagus and right hiatal pillar, and two further sutures between the fundus and the apex of the hiatus.

**Keywords** Gastroesophageal reflux · Fundoplication · Laparoscopy

## Introduction

Gastro-oesophageal reflux is common in Western countries, with 10 % of these populations reporting daily reflux symptoms and up to 50 % experiencing at least some symptoms every few months.<sup>1, 2</sup> Treatment of reflux aims for symptom control, as well as minimal treatment-related side effects and complications. Whilst most patients are treated with acid-suppressing medications, surgery continues to have an important role in the treatment of patients in whom reflux symptoms are not well controlled by medication. The standard approach to surgery in many parts of the world is the Nissen fundoplication procedure. However, the outcome following this procedure is less than satisfactory in some

individuals, with risks of recurrent reflux and side effects impacting on longer-term success. At 5–10 years follow-up, success rates of 85–90 % are generally reported.<sup>3, 4</sup> However, this means that a poorer outcome is reported by the remaining 10–15 %. In particular, some individuals report problems with troublesome dysphagia and wind-related side effects such as abdominal bloating, inability to belch and flatulence, and in some of these, side effects offset the benefits of reflux control.<sup>3, 4</sup>

Side effects are usually associated with the over-competent lower oesophageal sphincter which follows a Nissen fundoplication. This can result in impairment of the passage of food boluses across the gastro-oesophageal junction and inability to belch gas from the stomach.<sup>5</sup> The use of a partial fundoplication has been advocated as a strategy to reduce the risk of these side effects. Meta-analysis of randomised trials of Nissen vs. partial fundoplication confirms a reduced side effect profile following partial fundoplication techniques.<sup>6</sup>

One approach to constructing a partial fundoplication is an anterior 180° partial fundoplication. This approach was originally proposed by Dor et al.<sup>7</sup> and was initially used to prevent reflux following cardiomyotomy for achalasia. Dor's original technique entailed suturing the anterior wall of the gastric fundus to the cut edges of the myotomy, along the left and then right sides of the oesophagus. We have modified and simplified this approach for use as an

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antireflux procedure, and the modified procedure applied to the treatment of gastro-oesophageal reflux is described in the current paper. Published data from randomised trials have verified that anterior 180° partial fundoplication controls reflux, with reduced side effects, at up to 10 years follow-up.<sup>8</sup> Hence, the anterior 180° partial fundoplication procedure has now become our preferred approach to surgery for gastro-oesophageal reflux. In this paper, we detail our approach to this procedure.

### Pre-operative Workup

Pre-operative workup entails a full history, focussing specifically on upper alimentary symptoms including reflux, regurgitation, dysphagia and post-prandial chest pain. Patients also undergo routine upper alimentary endoscopy to delineate relevant anatomy, assess for evidence of reflux oesophagitis and exclude other pathologies. Twenty four-hour ambulatory pH monitoring is used to confirm gastro-oesophageal reflux disease and oesophageal manometry to evaluate oesophageal motility.

### Case Selection

In 1995, when we first performed anterior 180° partial fundoplication for the treatment of reflux, we were selective in our approach, initially applying this operation only in patients with significant oesophageal dysmotility. However, with increasing experience and the reassurance of satisfactory longer-term outcomes, we have become progressively less selective and now offer this procedure to all patients undergoing surgery for gastro-oesophageal reflux, irrespective of any perceived risk factors such as a large hiatus hernia, Barrett's oesophagus or more severe grades of oesophagitis. We also add this procedure in all patients undergoing cardiomyotomy for achalasia. At present, we construct a Nissen fundoplication in less than 20 % of patients presenting for antireflux surgery.

### Anaesthetic Considerations/Technique

Patients are given a single dose of intravenous antibiotics on induction of anaesthesia. Opioid analgesia is avoided, and intraoperative ondansetron or tropisetron is given to minimise the risk of post-operative nausea and vomiting.

### Theatre Set-Up

The patient is positioned supine, in the lithotomy position, with legs extended in the stirrups and knees level with the hips (Fig. 1). The head of the bed is then elevated so that the



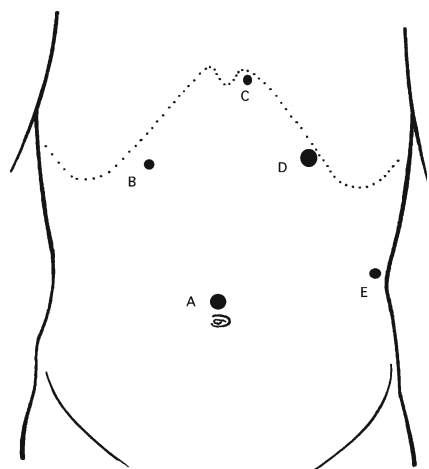
**Fig. 1** Patient positioning for fundoplication. The legs are extended in stirrups, with minimal hip flexion; the patient is positioned 20–30° head up, and the surgeon operates from between the legs

patient is in 20–30° reverse Trendelenburg. The operating surgeon stands between the patient's legs with the assistant on the patient's left side and scrub nurse on the patient's right side. The video monitor is placed in line with the patient's head, level with the surgeon's eyes or adjacent to the patient's right shoulder. Four operating ports (two 11 mm and two 5 mm) and a Nathanson liver retractor (Cook Medical Technology, Eight Mile Plains, Queensland, Australia) are used. An “iron intern” is used to fix the liver retractor to the operating table. Instrumentation consists of two plain grasping instruments, a diathermy hook and a single needle holder for the surgeon, and one atraumatic grasper, laparoscopic scissors and a 30° 10-mm laparoscope with camera for the assistant.

### Surgical Technique

#### Hiatal Exposure and Oesophageal Mobilisation

Using an open insertion technique, an 11-mm port is inserted immediately supra-umbilically, and a pneumoperitoneum is obtained (Fig. 2). This port is used for the laparoscope. In some obese individuals or individuals with a pendulous abdomen, this site can be too low, and an additional 11-mm port can be inserted in the midline, halfway between the umbilicus and the xiphoid to improve access. The Nathanson liver retractor is next introduced through a 5-mm stab wound sited high in the epigastrium, immediately to the left side of the xiphoid process, and the left lobe of the liver is elevated to expose the upper stomach and the oesophageal hiatus. A further 11-mm and two 5-mm ports are sited next. Five-millimetre ports are placed in the right midclavicular line immediately below the costal margin for the surgeon's left-hand instruments and in the left anterior axillary line 3–4 cm below the costal margin for the



**Fig. 2** Port placement for fundoplication: **a** camera port, **b** and **d** surgeon's operating ports, **c** liver retractor insertion site, **e** port for assistant's retractor (Figure reproduced from Wijnhoven and Watson<sup>16</sup>)

assistant's instruments. An 11-mm port is placed in the left midclavicular line immediately below the costal margin for the surgeon's right-hand instruments.

Initial dissection entails dissection of the oesophageal hiatus and mobilisation of the oesophagus. The assistant uses an atraumatic grasper on the fat pad overlying the gastric cardia to retract the gastro-oesophageal junction downwards and away from the area dissected. Initially, retraction is to the left, as the first step is to open the pars flaccida and lesser omentum on the right side of the oesophageal hiatus, above and below the hepatic branch of the anterior vagus nerve. This nerve is preserved as it provides parasympathetic innervation to the gall bladder and the pylorus, and in addition, when the fundoplication is placed above the preserved nerve, the nerve ensures that the wrap is correctly placed adjacent to the distal oesophagus. Opening the lesser omentum first allows the right hiatal pillar to be demonstrated within the lesser sac, before the phreno-oesophageal ligament is opened and divided. Usually some fat overlies the area of dissection on the right side of the oesophagus, and this should be dissected away to expose the insertion of the phreno-oesophageal ligament onto the right side of the gastro-oesophageal junction. Similarly, peritoneal and fatty attachments between the upper stomach near the angle of His and the left hemidiaphragm should be bluntly dissected to expose the insertion of the phreno-oesophageal ligament onto the left side of the gastro-oesophageal junction.

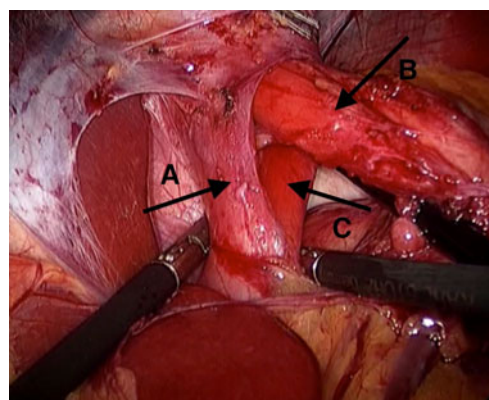
The oesophageal hiatus is opened, initially by dividing the phreno-oesophageal ligament inside the anterior edge of the right hiatal pillar, near where it inserts onto the oesophagus. As the correct dissection plane is avascular, this can be undertaken using a blunt dissection technique. Dissection continues anteriorly towards the apex of the oesophageal hiatus, separating the diaphragm from the oesophagus and

the cardia. It continues across to the left side and then downwards between the left hiatal pillar and the left side of the oesophagus. Dissection continues as far posteriorly as possible to facilitate posterior oesophageal dissection.

The oesophagus should now be virtually fully mobilised, and further minimal posterior dissection behind the oesophagus from the right side allows the passage of the grasper in the surgeon's left hand behind the oesophagus. The oesophagus is then slung with a nylon tape, introduced from the 11-mm left upper abdominal port, transferred to the surgeon's left hand grasper and then passed behind the oesophagus and withdrawn via the same 11-mm port. The port is then removed, and the ends of the tape are retracted and tethered with an artery clip extracorporeally, before reinserting the port so that the tape now lies outside the port. This allows extracorporeal retraction of the oesophagus anteriorly and caudally to fully expose the left and right hiatal pillars, which should then be dissected to their confluence (Fig. 3). The posterior vagus nerve is also dissected away from the oesophagus so that it lies away from the oesophagus, close to the confluence of the hiatal pillars, and ultimately behind the hiatal repair sutures. If any further hiatal surgery is then required, the posterior vagus nerve will be separated from the oesophagus and at less risk of injury during revision.

### Hiatal Repair

Non-absorbable monofilament sutures are used. The posterior aspects of the hiatal pillars are approximated with interrupted sutures, spaced approximately 5 mm apart, commencing posteriorly and working anteriorly. Substantial “bites” of the pillars are incorporated with each suture to ensure a stable repair, and care should be taken to ensure that the pillars are opposed but not strangulated by each suture. An intra-oesophageal bougie is not required to calibrate the diaphragmatic closure; rather, the closure is



**Fig. 3** The hiatus is dissected fully to expose the junction of the hiatal pillars. **A** right hiatal pillar, **B** intra-abdominal oesophagus, **C** left hiatal pillar

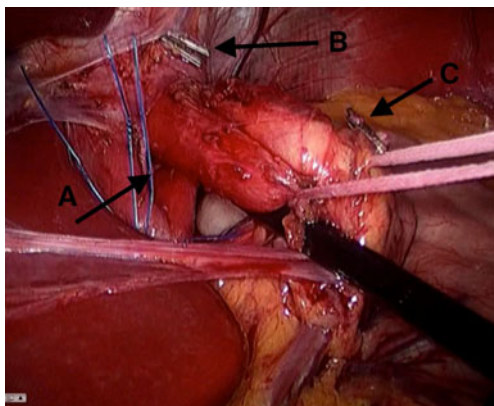


tailored to leave approximately 5–7 mm of space posteriorly between the posterior oesophagus and uppermost hiatal repair suture, when the oesophagus is lifted anteriorly (Fig. 4). This usually entails reducing the hiatus to approximately 25–30 mm diameter. One or two sutures are usually placed in patients with either no hiatal hernia or a very small hernia. Additional sutures are required for patients with larger hiatal defects. Currently, we are only using mesh to reinforce the hiatal repair within the context of a randomised trial.

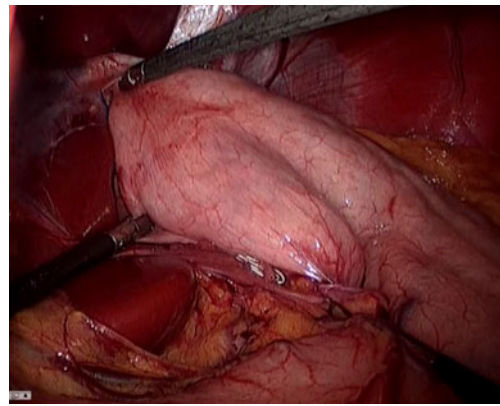
#### Construction of the Fundoplication

The next step is the construction of the anterior 180° partial fundoplication. The first step is selection of the correct piece of the gastric fundus for the wrap. Whilst the assistant retracts the cardia and oesophagus caudally towards the pelvis, the anterior wall of the fundus, immediately adjacent and lateral to the cardia, is grasped and drawn medially across the front of the oesophagus. If this can be loosely placed across the gastro-oesophageal junction and reach the anterior hiatal repair suture, the adjacent more superior area of the anterior fundus can usually be lifted to reach the apex of the hiatus. It is important to ensure that the fundus can be positioned loosely across the anterior oesophageal wall, so that it reaches the right hiatal pillar without tension (Fig. 5). If any tension is evident, the fundus can always be incrementally adjusted until it lies loosely across the hiatus. Division of the short gastric vessels is never required.

The proposed site for the placement of the first (lowest) fundoplication suture is then temporarily marked on the gastric wall by squeezing the gastric wall between the jaws of the surgeon's grasping instrument. The fundoplication is then constructed. Deep “bites” of all structures—stomach, oesophagus and hiatal rim—are required to ensure the long-term stability of the wrap. Small tentative sutures should be avoided as they are likely to pull out and lead to unravelling of the fundoplication.



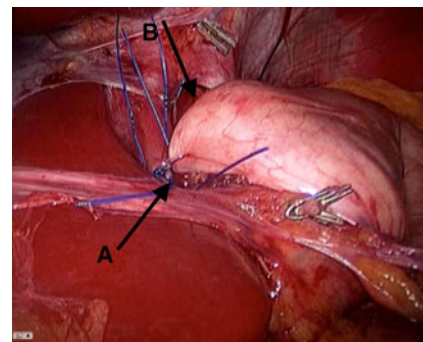
**Fig. 4** After hiatal repair, there is still some space (marked A) between the oesophagus and the uppermost suture. Note: in this procedure, an aberrant left inferior phrenic artery has been clipped (B and C) and divided to allow adequate hiatal dissection



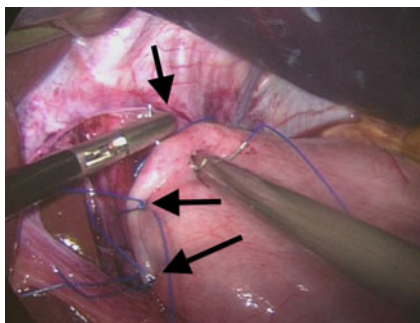
**Fig. 5** The anterior wall of the fundus is manipulated until it sits loosely across the front of the oesophagus

Accurate placement of the first suture is critical as it sets up the other fundoplication sutures. This is placed first through the previously “marked” gastric wall, then deeply through the wall of the right postero-lateral oesophagus (7–8 o'clock position) at least 15–20 mm above the gastro-oesophageal junction and then finally through the right hiatal pillar at the level of the highest previously placed hiatal repair suture. This suture is then secured to oppose all three structures (Fig. 6). Once secured, the stomach forms a ridge or edge overlying the oesophagus and the anterior hiatus. It is then quite easy to identify the correct position for suture placement for all subsequent sutures.

The second suture is placed above the first suture and incorporates the fundus 5–7 mm along the ridge of the anterior fundus, then the right antero-lateral wall of the oesophagus 5 mm cranial to the first suture and the right hiatal pillar 5 mm above the first suture. A third suture is placed a further 5–7 mm above the second suture, incorporating the ridge of the anterior fundus, the oesophagus and the right hiatal pillar. Hence, three sutures approximate the anterior fundus, the intra-abdominal oesophagus and the right hiatal pillar. This stabilises 3–4 cm of intra-abdominal oesophagus and fashions a flap valve which prevents reflux (Fig. 7). Attachment of the



**Fig. 6** Placement of the first fundoplication suture anchors the fundus, oesophagus and right hiatal pillar (A). Subsequent sutures are placed through the ridge of the stomach which forms across the front of the oesophagus (B)



**Fig. 7** Three sutures (marked with *arrows*) are placed between the anterior wall of the fundus, the oesophageal wall and the right hiatal pillar

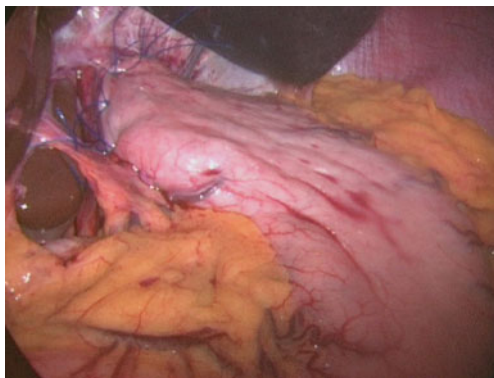
fundoplication to the right hiatal pillar stabilises the wrap and prevents any risk of torsion or rotation of the oesophagus.

Finally, two “crown” sutures are placed to complete the fundoplication (Fig. 8). The first attaches the apex of the fundoplication to the hiatal rim at the 11 o'clock position, and the second attaches the stomach to the hiatal rim or adjacent diaphragm at the 1–2 o'clock position. These sutures do not incorporate the oesophageal wall.

As well as for the surgical treatment of gastro-oesophageal reflux, we often use an anterior 180° partial fundoplication during repair of a very large hiatal hernia. We have never undertaken an oesophageal lengthening procedure during primary antireflux surgery or hiatus hernia repair and are unable to report any experience with combining an anterior 180° partial fundoplication with a Collis procedure in patients perceived to have a shortened oesophagus.

### Intraoperative Complications

Bleeding from the liver occasionally occurs because of local trauma from the liver retractor or direct surgical trauma, but is usually minor and ceases without specific intervention. Bleeding from the short gastric vessels should not occur as these vessels are not divided. Damage to the oesophagus or



**Fig. 8** Completed anterior 180° partial fundoplication, after placement of two apical sutures

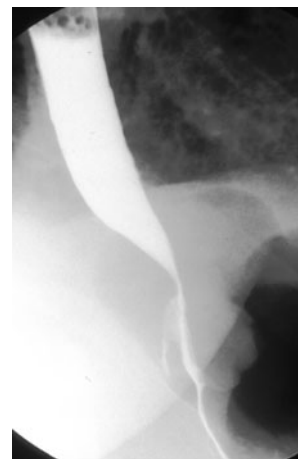
stomach may rarely occur during dissection, and care should be taken to pass the laparoscopic grasper behind the oesophagus under direct vision. Risks are minimised by always dissecting in natural tissue planes and using blunt instruments to separate tissues. Ultrasonic shears are never required, although electrocautery is occasionally used if tissues are particularly tough.

### Post-operative Care

Following surgery, patients return to a general ward and commence oral fluids on the same day. Opiate analgesia is avoided to minimise the possibility of post-operative vomiting. Local anaesthesia is infiltrated into the surgical wounds peri-operatively, and oral or intravenous paracetamol, supplemented by non-steroidal anti-inflammatory agents, are used for analgesia. Antireflux medication is ceased. On the first post-operative day, a pureed diet is commenced, and a barium swallow X-ray is routinely undertaken to check the post-operative anatomy (Fig. 9).<sup>9</sup> The patient is discharged on the first or second post-operative day, and the pureed diet is continued until follow-up 4 weeks later, after which the diet is graded back to normal over the ensuing 4–8 weeks.

### Clinical Outcomes

Ten-year outcomes from a randomised controlled trial of anterior 180° partial vs. Nissen fundoplication have been reported previously.<sup>8</sup> These demonstrated effective reflux control and a low side effect profile, although some trade-offs were evident between a higher risk of recurrent reflux vs. a lower risk of side effects following anterior 180° partial



**Fig. 9** Post-operative Barium swallow X-ray (lateral view) after anterior 180° partial fundoplication. The oesophagus lies in a relatively straight (anatomical) position and is not lifted forward by placing the fundus behind the oesophagus

fundoplication. Overall, the data from this randomised trial confirmed that anterior 180° partial fundoplication provides a good outcome in more than 90 % of patients at 10 years follow-up. Similarly, a recent meta-analysis of 5-year outcome data from four randomised trials of anterior vs. Nissen fundoplication also identified similar reflux control but less side effects following anterior 180° partial fundoplication.<sup>10</sup> In addition, objective outcomes at early follow-up in the randomised controlled trial of anterior 180° partial vs. Nissen fundoplication confirm effective reflux control, with normalisation of 24-h pH profiles and healing of oesophagitis.<sup>11</sup>

Poorer outcomes following anterior partial fundoplication have been reported by Engstrom et al., with worse control of reflux compared to posterior partial fundoplication.<sup>12</sup> This is probably due to the application of a different surgical technique for anterior partial fundoplication. They constructed a lesser 120° partial fundoplication and did not anchor the wrap to the right hiatal pillar. This lack of anchorage might lead to unravelling of the wrap and a higher risk of recurrent reflux. Others have suggested that posterior partial fundoplication procedures might be relatively less effective in patients with more severe grades of gastro-oesophageal reflux.<sup>13, 14</sup> However, there is no high-level evidence supporting this proposition, and these earlier studies provided low-level evidence from uncontrolled cases series.

More recently, we reported follow-up of 548 patients who underwent an anterior 180° partial fundoplication.<sup>15</sup> This study included patients with all grades of oesophagitis, Barrett's oesophagus and very large hiatal hernia. In this larger series, the median operating time was 60 min, and the conversion rate to open surgery was 2.6 %. Fourteen patients (2.6 %) underwent early re-operation within 1 week of the original procedure (ten for acute hiatus hernia, two for dysphagia and two for intra-abdominal sepsis). Seventeen (3.1 %) patients underwent a later re-operation—13 for recurrent reflux and 3 for recurrent hiatal hernia. There was one (0.2 %) peri-operative death secondary to myocardial infarction, occurring 13 days after surgery in an 83-year-old man who underwent surgery for a very large hiatal hernia with intermittent gastric volvulus. Clinical follow-up with analogue scores which assessed outcomes for heartburn, dysphagia and overall satisfaction revealed considerable improvement in heartburn and dysphagia following surgery and stable outcomes for dysphagia and overall satisfaction at up to 10 years follow-up. However, there was an increase in heartburn scores at 5 and 10 years, compared to follow-up at 3 months and 1 year, suggesting some deterioration in reflux control at extended follow-up. However, recurrent reflux also occurs after other types of fundoplication, and the overall results following anterior 180° partial fundoplication were good. In addition, at late follow-up, 89.0 % of patients could belch effectively, and 88.3 % were eating a normal diet. Of the patients, 11.7 % avoided some

food types because of either food intolerance or dysphagia. Of the patients followed for 10 years or more, 91.0 % considered their decision to originally undergo surgery to have been correct. The results from this study, as well as the 10-year outcomes from the randomised trial of anterior 180° vs. Nissen fundoplication,<sup>8</sup> confirm the durability of this approach, demonstrating equivalent reflux control but less side effects, compared to Nissen fundoplication.

Based on these outcomes, we are now happy to offer an anterior 180° partial fundoplication to all patients presenting for surgery for gastro-oesophageal reflux. For those deemed to be at a higher risk of side effects following Nissen fundoplication, we would always recommend an anterior 180° partial fundoplication, whereas for younger patients and those assessed to be at a lower risk of side effects, we offer a choice between anterior 180° vs. Nissen fundoplication, with approximately two thirds of these choosing to undergo a partial fundoplication.

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