



Results after minimally invasive Toupet fundoplication technique: a narrative review

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Abstract: Posterior partial fundoplication (PPF) was developed as an alternative surgical strategy to Nissen fundoplication, in attempt to reduce the rate of side-effects, mainly dysphagia and gas bloat syndrome. Allowing patients to maintain belching ability, this operation could lead to minor gas-related symptoms than total fundoplication. The procedure was first described by André Toupet in 1963 and consisted of a posterior 180° wrap of the gastric fundus through a midline incision. After the first report of anti-reflux surgery performed with the laparoscopic approach, several authors have translated PPF into a minimally invasive approach. A review of literature has been performed to evaluate the results of minimally invasive PPF, focusing on the rate of dysphagia and gastro-esophageal reflux disease (GERD) recurrence. The evidence suggests that laparoscopic PPF is a safe and feasible procedure, and provides similar reflux control compared to laparoscopic total fundoplication, with lower risk of postoperative dysphagia. However, the duration of laparoscopic PPF effect on reflux control over time is questioned, as data on long-term results after laparoscopic Toupet fundoplication are lacking. Further studies are needed to provide long-term functional and clinical results of laparoscopic PPF in order to draw definitive conclusions. Therefore, the controversy regarding the optimal surgical strategy for the management of gastroesophageal reflux continues.

Keywords: Laparoscopic Toupet fundoplication; laparoscopic posterior partial fundoplication; gastro-esophageal reflux disease; minimally invasive surgery

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Introduction

Laparoscopic fundoplication is considered the standard surgical treatment for patients with gastro-esophageal reflux disease (GERD). It determines excellent control of symptoms both at short and long-term follow-up (1,2). However, laparoscopic fundoplication is associated with the presence of side-effect, mainly new onset of dysphagia and gas-bloat syndrome (3).

Posterior partial fundoplication (PPF) was described by André Toupet as an open procedure in 1963, in attempt to reduce the rate of dysphagia and gas bloat syndrome that occurred after Nissen fundoplication (4). The operation

was performed through a midline incision, and the original technique described a partial wrap of the gastric fundus behind the mobilized esophagus without short gastric vessels division. This technique initially proposed as a 180° posterior wrap, and subsequently modified to a 270° wrap, did not originally include a hiatoplasty except in case of very enlarged hiatus.

Proponents of the Toupet technique argue that, allowing patients to vent air from the stomach, PPF could result in minor mechanical disadvantages in comparison to total fundoplication, without losing efficacy on reflux control (5).

With the advent of laparoscopy and the recognition of its

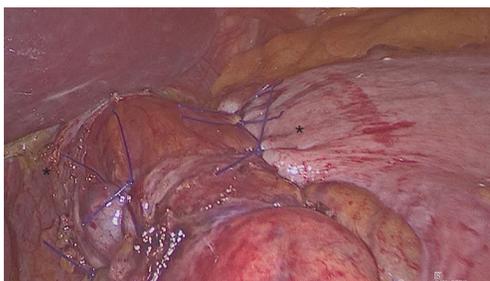


Figure 1 Laparoscopic posterior partial fundoplication. Intraoperative image of posterior partial fundoplication. The gastric fundus is then anchored to the right and to the left aspects of the esophagus (asterisks) with interrupted sutures.

advantages over the open approach, this technique has been translated into minimally invasive surgery (6). However, data specifically assessing the comparison between open and laparoscopic posterior partial fundoplication (LPPF) are scarce. Only Hakanson *et al.* reported the results of a randomized controlled trial comparing 93 patients submitted to open and 99 patients to LPPF (7). This study showed that complication rates and length of stay were higher in the open group, while at medium-term follow-up (3 years) there were no differences in terms of reflux control, use of medications and overall patients' satisfaction between the two groups. For these reasons, laparoscopic surgery was considered the treatment of choice.

The aim of this paper is to provide a narrative review the literature on the results of minimally invasive Toupet fundoplication technique. We present the following article in accordance with the Narrative Review reporting checklist (available at <http://dx.doi.org/10.21037/ls-20-101>).

Surgical technique

The procedure can be formed laparoscopically or with the robotic approach (8). When performed laparoscopically, five trocars are needed; when performed with the DaVinci Xi Surgical System (Intuitive Surgical Inc., Sunnyvale, CA, USA) four robotic trocars are introduced, and two additional laparoscopic trocars are placed for exposure. Operative steps are the same either with the laparoscopic and the robotic approach. The first step of the procedure is the exposure of the esophageal hiatus: the right and left diaphragmatic crura are visualized and the posterior aspect of the esophagus is dissected in order to create a retrosophageal window. A vessel loop is passed around the

esophagus to provide inferior traction, helping esophageal mobilization, until at least 2–3 cm of the lower esophagus remain in abdomen without tension. At this point the gastric fundus can be pulled behind the esophagus to the right of the patient, without short gastric vessel division. A hiatoplasty with interrupted sutures is required. The gastric fundus is then anchored to the right and to the left aspects of the esophagus with interrupted sutures (*Figure 1*). Furthermore, some authors propose to anchor the gastric wrap to the crura, as described in the original Toupet technique (4).

Postoperative care

The nasogastric tube is removed at the end of the surgical procedure, except in the case of a concurrent large paraesophageal hernia repair. On the first postoperative day patients are allowed to start with clear liquids, while soft meal is introduced the day after. The discharge generally takes place on second postoperative day. Patients are instructed to a detailed diet with semi-solid foods for at least 30 days (9,10).

Short- and medium-term results

Several studies have evaluated the short-term outcomes of LPPF, demonstrating safety, feasibility and effectiveness of the procedure (*Table 1*) (11–17).

More recently, the medium-term results of series of LPPF were published. For instance, Omura *et al.* described the results of 375 patients undergoing laparoscopic Toupet fundoplication between 1997 and 2016. Clinical recurrence of symptoms was experienced in 15.1% of cases. Patients were therefore divided into 2 groups based on the presence of GERD recurrence. The authors concluded that longer preoperative acid reflux time, the presence of hiatal hernia, and the severity of reflux esophagitis were predictive factors of recurrence after LPPF (19).

Also, Bona *et al.* performed a medium-term analysis on 348 GERD patients submitted to LPPF. A bio-synthetic mesh was added for crural augmentation in 177 (51%) patients. At a mean follow-up of 37 months, 95% of patients was satisfied about the procedure, with only 1.1% patients complaining of persistent dysphagia (20).

The results of 5-year follow-up of 100 consecutive LPPF patients was published by Zehether *et al.* The rate of endoscopic dilatation for persistent dysphagia was 5% after 12 months from the surgical procedure. At 5 years

Table 1 Summary of studies reporting short and medium-term follow-up after laparoscopic partial posterior fundoplication

Author	Year	N	Operative time (minutes)	Conversion to open	Intraoperative complications	Postoperative morbidity	Length of stay (days)	Follow-up (months)
O'Reilly <i>et al.</i> (11)	1996	100	N/A	0%	N/A	4%	1.6	N/A
Patti <i>et al.</i> (12)	1997	26	184±10	0%	0%	11.5%	1.7	11
Lefebvre <i>et al.</i> (13)	1998	100	N/A	1%	N/A	4%	4	12
Horvath <i>et al.</i> (14)	1999	48	N/A	0%	N/A	N/A	N/A	22
Pozo <i>et al.</i> (15)	2001	122	N/A	0%	N/A	NA	1–2	12
Zehetner <i>et al.</i> (16)	2006	100	112±40	0%	0%	9%	5.5	60
Almond <i>et al.</i> (17)	2010	101	N/A	0%	N/A	N/A	2	N/A
Wenck <i>et al.</i> (18)	2010	100	50	0%	N/A	N/A	5	N/A
Omura <i>et al.</i> (19)	2018	375	141	0%	3.5	6.9	7	59
Bona <i>et al.</i> (20)	2020	348	122	0%	0%	2.3%	1.8	37

N/A, not available.

follow-up, overall satisfaction was 96.3%. Clinical GERD recurrence occurred in 15% of patients, while occasional dysphagia was present in 2% of patients (16).

Long term results

Long term results (>10 years) of LPPF are scarce. Dallemagne *et al.* reported the long-term follow up results of a prospective observational study comparing laparoscopic total (68 patients) *vs.* LPPF (32 patients). At 10-year follow-up patients were investigated with a structured symptom questionnaire, showing that 81.8% of patients submitted to LPPF were free from GERD symptoms and occasional postoperative dysphagia was experienced in 25% of patients (21).

The only study specifically assessing long-term results of Toupet fundoplication is the one performed by Franzen *et al.*, with the open approach. They described the long-term results of 101 patients submitted to open PPF between 1982 and 1989. At 10 years after surgery, recurrence rate was 8%, and patients with severe preoperative esophagitis were at higher risk of developing recurrence. Therefore the authors concluded that in severe GERD patients Toupet fundoplication was not indicated (22).

Toupet vs. Nissen

In the last two decades, several RCTs compared LPPF and Nissen fundoplication, showing minimal differences

between the two procedures (23–26). Furthermore, various meta-analysis were conducted to clarify which was the best surgical procedure for GERD (27–32). These studies agreed in the description of LPPF as the procedure that guarantees the best balance between reflux control and side-effects. For instance, in a recent network meta-analysis including 29 RCTs that compared different laparoscopic anti-reflux procedures, Andreou *et al.* concluded that Toupet fundoplication was equally effective as Nissen fundoplication in reflux control, morbidity and reoperations, while it was associated with lower dysphagia and gas-bloat syndrome (33).

However, the reliability and accuracy of the results of these meta-analyses are limited, due to the extreme heterogeneity between the studies regarding the methodological quality of the included studies, preoperative indications, patients baseline characteristics, and surgical technique performed (200–270° degree of partial wrap, use of a bougie, crural repair, short gastric vessel division, length of the fundoplication, inclusion of open procedures). Furthermore, the duration of follow-up, that was less than 5 years in the majority of included studies, cannot allow to draw definitive conclusions on long-term effectiveness of the procedures.

In the 1990's, in the debate between total and partial fundoplication, the so called "tailored approach" came into vogue. Some studies showed that the postoperative functional results appeared to be better after LPPF, particularly in the subgroup of GERD patients with

esophageal dysmotility (34,35). Therefore, some authors proposed to select for Toupet fundoplication patients who were at higher risk of developing postoperative dysphagia after Nissen fundoplication, such as patients with impaired peristalsis (36).

However, subsequent RCTs aiming to clarify the best procedure between LPPF and Nissen fundoplication for patients with impaired peristalsis, did not confirm these results (12,14,37-39). Therefore, this approach, of tailoring degree of fundoplication based on results of preoperative esophageal motility studies, has been abandoned.

One of the main claims against Toupet fundoplication is the uncertainty regarding the maintenance of its effects over time. In fact, some authors reported poorer reflux control after LPPF than Nissen fundoplication at long-term follow-up, and it seems that the mechanical advantages of Toupet fundoplication tend to disappear with time (12,32,40-43).

Toupet vs. anterior partial

After the description of posterior partial 180° fundoplication by Toupet, further modifications of the original Nissen fundoplication, in an attempt to find the best procedure capable of ensuring lower side effects maintaining reflux control, led to the development of anterior partial fundoplications.

Laparoscopic anterior partial fundoplications (LAPF) were associated to fewer side effects than Nissen fundoplication. Broeders *et al.*, analyzing the raw data set of 4 RCTs comparing Nissen and LAPF, demonstrated that at 5 years of follow-up, reflux control was similar between Nissen and 180° LAPF, but lower after 90° LAPF. The authors concluded that the results supported the use of 180° LAPF in the surgical treatment of GERD (44).

Several studies aiming to compare LAPF vs. LPPF were performed (45,46). For instance, Roks *et al.* performed a two-center double-blind RCT comparing laparoscopic Toupet and 180° LAPF (47 patients in each group). No differences between the two procedures in the rate of postoperative dysphagia and in reflux control were detected at 1 year follow-up (47).

Also, Daud *et al.* performed a multicenter RCT comparing 180° LAPF (23 patients) and LPPF (24 patients). The results were inconclusive, but a trend towards higher reflux symptoms and pH score after LAPF was present already 12 months after surgery (48).

However, small sample sizes and short-term follow up of studies comparing LAPF and LPPF partial fundoplication

could not draw definitive conclusions on the role of anterior partial fundoplication.

Conclusions

Since the first description of posterior partial fundoplication by Andre Toupet in 1963, this procedure has gained wide acceptance. Safety and feasibility of this procedure performed with minimally invasive approach have been demonstrated by several series. The short- and medium-term results of RCTs showed similar reflux control compared to Nissen fundoplication, with lower side effects. However, long term data are lacking and the durability of Toupet procedure over time is questioned. Therefore, the debate on which should be considered the best anti-reflux procedure in the surgical management of GERD, remains open.

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