

Laparoscopic Toupet versus Nissen fundoplication for the treatment of gastroesophageal reflux disease: Randomized prospective study

Original
Article

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ABSTRACT

Objective: To compare laparoscopic Nissen fundoplication and laparoscopic Toupet fundoplication in terms of postoperative acid reflux control and postoperative complications, especially dysphagia and gas bloat on a short-term basis.

Patients and Methods: This prospective randomized study included 50 patients with gastroesophageal reflux disease who presented at Gastrointestinal Surgical Center, Mansoura University, for antireflux surgery from August 2021 to August 2022.

Results: The incidence of dysphagia was higher in the Nissen group than in Toupet in early postoperative follow-up (3 months) compared with the Toupet group ($P=0.008$), but the incidence of dysphagia decreased among the Nissen group during follow-up periods while no incidence of dysphagia in Toupet group ($P=0.077$).

Regarding heartburn score, there was no statistical significance between the two groups Toupet and Nissen ($P=0.200$) at early follow-up periods. However after 18-month postoperative, Nissen group showed better control of heartburn symptoms when compared to the Toupet group ($P=0.045$).

In the current study, according to quality of life after 1 year and patient satisfaction, there was no significant difference between the two procedures ($P=0.059$).

Conclusion: Nissen fundoplication shows a high incidence of dysphagia and gas bloat symptoms during early postoperative periods when compared with Toupet fundoplication, but this incidence decreases along follow-up periods. On the other hand, Nissen fundoplication shows better acid reflux control all over the follow-up periods.

Key Words: Gastroesophageal reflux disease, gastroesophageal reflux disease quality of life, laparoscopic Nissen fundoplication, laparoscopic Toupet fundoplication.

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INTRODUCTION

Gastroesophageal reflux disease (GERD) is a very common worldwide disease, and it affects about 15–20% of the whole world's population and leading to major burden on healthcare systems^[1].

Although GERD lifestyle modifications and acid-suppressing medications can often be the ideal treatment for GERD, surgical management can be the ideal solution in several conditions: (a) failed medical treatment, (b) the compliant patient to proton pump inhibitors, (c) Barrett's esophagus or peptic stricture, or (d) extra esophageal manifestations of GERD (asthma, hoarseness, cough, chest pain)^[2].

Since the 1950s, multiple ant reflux surgeries have been developed. The main goal of these procedures

is to re-establish an effective antireflux valve at the gastroesophageal junction^[3].

In 1956, Rudolph Nissen described a 360° (complete) fundoplication fashioned from the gastric fundus^[4]. Nowadays, it is the most commonly performed antireflux surgery, with good relief of reflux symptoms with low hospital stay^[5].

Although Nissen fundoplication has known to be a very effective antireflux surgery and up to 90% of patients report a great improvement of reflux symptoms following Nissen fundoplication, it has a significant adverse effects also reported by patients such as dysphagia (8–12% of patients) and gas bloating and flatulence (up to 19% of patients)^[6].

Partial fundoplication such as the Toupet posterior 270° and Dor anterior 90°–180° wraps were developed to

provides long-term GERD control as with the successful Nissen fundoplication, but with reduced postoperative side effects such as dysphagia and gas bloat^[7].

Toupet described the posterior partial fundoplication by Toupet in 1963. He used a similar technique to Nissen but attached the two parts of the gastric fundus to the esophagus and not to each other^[8].

Many studies have been conducted to study the efficiency of Nissen fundoplication and Toupet fundoplication in controlling acid reflux and the extent of complications like dysphagia and gas bloat after surgery^[9–12].

Patti and Mathew and their colleagues found that laparoscopic Toupet fundoplication had the same effectiveness on control of acid reflux with a significant decrease of postoperative dysphagia and gas bloat in comparison to laparoscopic Nissen fundoplication^[10,12].

In Wisconsin, Walle *et al.*^[11] found that the persistent postoperative dysphagia after antireflux surgery occurred in approximately one-quarter of patients and did not differ by the type of fundoplication.

Therefore, the question remains: what is the best antireflux surgery in terms of the effectiveness of controlling acid reflux and the lowest incidence of postoperative complications especially postoperative dysphagia?

The randomized prospective study is to compare laparoscopic Nissen fundoplication and laparoscopic Toupet fundoplication in terms of postoperative acid reflux control and postoperative complications, especially dysphagia and gas bloat on a short-term basis.

PATIENTS AND METHODS:

This prospective randomized study included patients with GERD who presented at Gastrointestinal Surgical Center, Mansoura University, for antireflux surgery from August 2021 to August 2022.

Patients were divided into two groups: group A included 25 patients who underwent laparoscopic Toupet fundoplication and group B included 25 patients who underwent laparoscopic Nissen fundoplication.

An informed written consent was obtained from all patients before the operation after a complete explanation of the benefits and complications of each procedure. Besides, the study was approved by the Institutional Review Board (IRB) of Mansoura University.

All patients included in this study had the following criteria: (a) age 18–60 years, (b) had symptoms of acid reflux mainly, regurgitation, and heartburn.

The diagnosis of GERD was established by: (a) 24-h ambulatory pH monitoring showing pathological acid reflux, (b) esophageal manometric study with a decrease of lower esophageal pressure, and (c) upper gastrointestinal endoscopy showing esophagitis with or without hiatus hernia.

Exclusion criteria included: (a) the presence of contraindication for laparoscopy, such as ASA III or IV, end-stage liver disease, severe cardiopulmonary disease, severe bleeding tendency, (b) BMI above 40 kg/m², (c) pregnancy, (d) previous antireflux surgery, (e) major psychiatric illness, and (f) esophageal motility disorders.

A sealed envelope technique was drawn in the operating room by a staff member not otherwise involved in the study, and this was how the randomization was done.

Preoperative workup

All patients were assessed preoperatively by a thorough history and physical examination. Upper gastrointestinal endoscopy was done for diagnosis and grading of GERD. All patients were assessed by 24 h pH monitoring to confirm the diagnosis and esophageal manometry to exclude motility disorders. Abdominal ultrasound was done to exclude other pathological conditions. Routine preoperative laboratory tests included a complete blood picture, liver, and renal function tests.

Operative technique

Laparoscopic Toupet fundoplication

First of all, the patient should be placed in lithotomy position and reversed Trendelenburg position, then the creation of pneumoperitoneum and five trocars were inserted (Fig. 1).

The procedure began with an incision of the gastrohepatic ligament, exposing the right crus of the hiatus (Fig. 2). If encountered, the accessory left hepatic artery was clipped and divided. Dissection was then continued to develop the plane between the esophagus and the right crus. The procedure is continued by division of the peritoneal reflection and the phreno-esophageal ligament at the anterior aspect of the esophagus, freeing the angle of His. Circumferential dissection continued towards the left crus, releasing it from the esophagus.

A tape was then passed around the lower esophagus and the posterior vagus to provide traction. Dissection of the esophagus continued through the hiatus into the mediastinum, avoiding injury of the pleura. The aim was to have at least 4 cm of intra-abdominal esophageal (Fig. 3).

Mobilization of the fundus was then done by dividing of all short gastric vessels using ultrasonic scissors to obtain a tension-free wrap.

Posterior crural repair was then performed using nonabsorbable interrupted sutures, which must have adequate bites of crus (muscle and overlying fascia) (Fig. 4).

The mobilized fundus was then delivered through the retroesophageal window, and a 'shoe-shine' maneuver was done to ensure that the wrap would not be under tension.

Creation of partial wrap was done by four nonabsorbable stitches (two on each side of the esophagus). Each one included the esophagus and gastric fundus, and the upper two stitches were placed 4 cm cranial to the gastroesophageal junction (Figs 5, 6).

Laparoscopic Nissen fundoplication

The same as Toupet fundoplication except for creating a complete 360° wrap by placing three sutures between gastric fundus and mobilizing greater curvature, one of them passing through esophagus. The first stitch should be high, about 4 cm cranial to the gastroesophageal junction, and the wrap not be placed into the body of the stomach (Fig. 7).

Postoperative period

Clear oral fluids were allowed on the night of the operative day and all patients in both groups were discharged the next day.

Evaluation for postoperative complication was done by Clavian–Dindo grading^[13].

Patients were listed for follow-up at 1, 3, 6, and 12 months intervals for the first year and then every year after.

The postoperative outcomes, including dysphagia, gas bloat, heartburn, and reflux symptoms, were assessed subjectively by modified Demeester clinical symptoms score^[14], and GERD quality of life (GERD-QOL) questionnaire was obtained from all patients after 1 year from operation^[15].

The postoperative gas bloat was assessed by a bloating questions on GERD-QOL questionnaire on a scale from 0 to 5, in which 0 represents (no symptoms), and 5 represents (incapacitating symptoms).

All patients who had persistent symptoms of dysphagia or recurrence of reflux and heartburn were investigated by barium study and upper gastrointestinal endoscopy.

Statistical analysis

The previously mentioned data were analyzed using SPSS software, (Statistical analysis was done using IBM

SPSS statistics for windows, Version 25.0. Armonk, NY: IBM Corp version 25 for Windows. Categorical data were expressed as numbers and percentages and then compared using the χ^2 test. Numerical data were expressed as medians (with range) or means (with SDs). The former was compared using the Mann–Whitney test and the latter using the Student t test. Any *P value* less than 0.05 was considered significant.

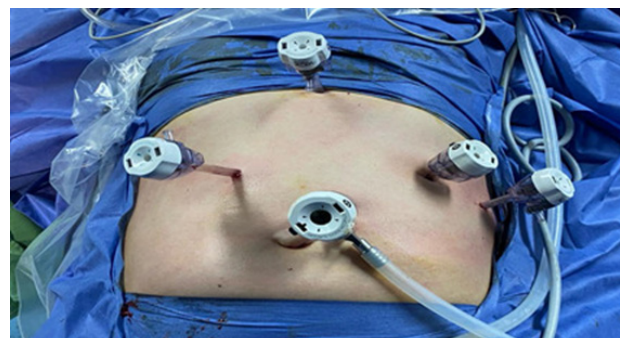


Fig. 1: Port design.

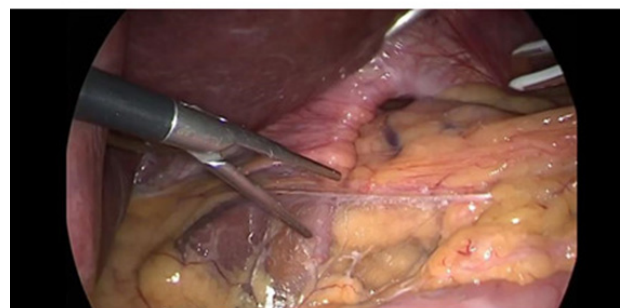


Fig. 2: Opening of gastrohepatic ligament.

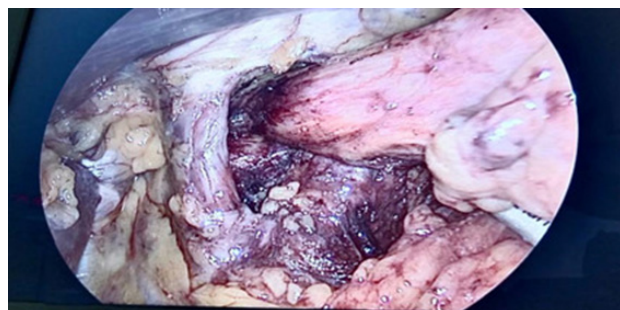


Fig. 3: Complete circumferential mobilization of esophagus and creation of retroesophageal window.

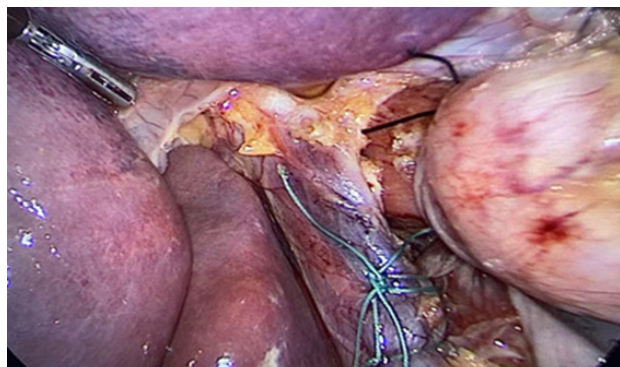


Fig. 4: Complete hiatus repair by non absorbable sutures (Ethibond).

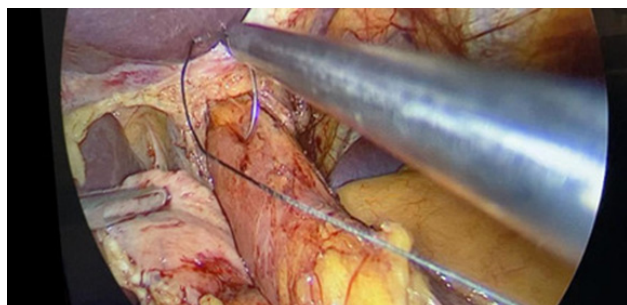


Fig. 5: Start wrap creation with first cranial suture by non-absorbable sutures.



Fig. 6: Final shape of Toupet Wrap.

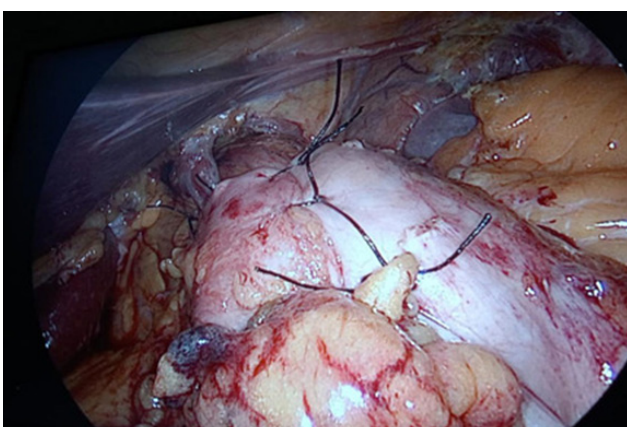


Fig. 7: Final configuration of Nissen Wrap.

RESULTS:

In the period between August 2021 and August 2022, 50 patients were included in the study. Twenty-five patients underwent laparoscopic Nissen fundoplication, and 25 underwent laparoscopic Toupet fundoplication as an antireflux surgery at Gastrointestinal Surgery Centre, Mansoura University.

Demographic and preoperative data

The demographic data and preoperative symptoms of the Nissen group and Toupet group were listed and statistically comparable in (Table 1), while the preoperative endoscopy, radiology, and Demeester scores were statistically comparable in (Table 2).

Operative data

The median operative time in Toupet group was 90 min (60–180 min) while in the Nissen group, it was 60 min (60–120) but without statistical significance ($P=0.341$).

No significant intraoperative complications were noted except for a single case of pleural injury in the Toupet group, which was sutured. Also there was no significant blood loss in either groups, with no need for perioperative blood transfusion.

Postoperative results

The mean length of hospital stay was 1 day (1–3) in the Toupet group and 1 day (1–5) in the Nissen group. No cases of early mortality were reported.

Most cases showed smooth postoperative course and only two showed early postoperative complications. One patient from the Toupet group had malignant hypertension, and one patient from the Nissen group had a chest infection both patients were managed medically in the ICU and discharged after complete recovery.

Early and intermediate-term results

Table 3 shows the early and intermediate-term results.

All patients included in this study completed at least 18 months follow-up as planned, except for two patients, one in each group.

Among Toupet group, one patient developed a recurrence of symptoms and dyspnea. A barium study was done 6-month postoperative revealed a disrupted migrated wrap, so he was listed for redosurgery, which was done by open hiatal repair and complete wrap.

Among the Nissen group, one patient developed severe dysphagia to liquids and solids and underwent balloon dilatation two times at 3 and 6 months postoperative with poor response. Then the patient was lost from follow-up in our outpatient clinic and underwent redosurgery outside our center.

Dysphagia

The incidence of dysphagia was higher in Nissen group than Toupet in early postoperative follow-up (3 months), with a mean±SD dysphagia score of 0.92 ± 0.95 in the Nissen group when compared with the Toupet group (0.28 ± 0.458) which is statistically significant ($P=0.008$) but the incidence of dysphagia decreased among Nissen group along follow up periods and mean±SD dysphagia score became (0.16 ± 0.48) among Nissen group while no incidence of dysphagia in Toupet group ($P=0.077$).

Only two (8%) patients needed balloon dilatation, with a good response in one of them, and the other one underwent redosurgery outside our center 6-month postoperative.

Gas bloat

Like dysphagia, during early postoperative period (3 months) patients in the Nissen group show a high incidence of gas bloat when compared to patients in the Toupet group (0.72 ± 0.842 vs. 0.44 ± 0.869) but without statistically significance ($P=0.100$) but the mean (SD) gas bloat score among Nissen group decreases along follow up periods to reach at 18-month postoperative (0.16 ± 0.48) while no patient among Toupet group had like symptoms at this follow-up period.

Heartburn

Regarding heartburn score, there was no statistically significance between the two groups Toupet (0.36 ± 0.637)

versus Nissen (0.2 ± 0.577) ($P=0.200$) at early follow-up periods. However, after 18-month postoperative, the Nissen group showed better control of heartburn symptoms with heartburn score (0.66 ± 0.868) when compared to the Toupet group (1.208 ± 0.93) ($P=0.045$).

Reflux

Also, the mean (SD) reflux score had no statistically significance during early postoperative periods (3 months) ($P=0.123$) but the Nissen group also showed good control of reflux symptoms along follow-up periods when compared with the Roupet group.

After 18-month postoperative, the mean (SD) reflux score among the Nissen group was 0.66 ± 0.868 , while among the Toupet group was 1.208 ± 0.93 , which is statistically significant ($P=0.045$) (Table 4).

Table 1: Demographic data, comorbidities, and clinical symptoms

	Toupet [n (%)]	Nissen [n (%)]	P value
Age (years)	44.92±11.8	45.2±11.59	0.778
Sex			
Male	12 (48)	16 (64)	0.254
Female	13 (52)	9 (36)	
BMI (kg/m ²)	29.07±3.77	30.636±5.188	0.233
Smoking			
No smoking	18 (72)	22 (88)	0.235
Active smoker	2 (8)	0	
Ex-smoker	5 (20)	3 (12)	
Comorbidities			
DM	0	1 (4)	0.312
HTN	4 (16)	6 (24)	0.480
Symptoms			
Heartburn	23 (92)	25 (100)	0.149
Regurgitation	21 (84)	17 (68)	0.185
Atypical symptoms	5 (20)	4 (16)	0.713

DM, diabetes mellitus; HTN, hypertension.

Table 2: Preoperative endoscopy, radiology, and Demeester score

	Toupet [n (%)]	Nissen [n (%)]	P value
Upper endoscopy			
Grade A	11 (44)	5 (20)	0.185
Grade B	13 (52)	19 (76)	
Grade C	1 (4)	1 (4)	
Barium study			
No hiatus hernia	4 (16)	1 (4)	0.312
Hiatus hernia	21 (84)	24 (96)	
Preoperative Demeester score	15.5±12.27	16.81±11.75	$P=0.535$

Table 3: Early and intermediate outcomes

	Toupet [<i>n</i> (%)]	Nissen [<i>n</i> (%)]	<i>P</i> value
Postoperative follow up at 3 months			
Dysphagia	0.28±0.458	0.92±0.95	0.008*
Gas bloat	0.44±0.869	0.72±0.842	0.100
Heartburn	0.36±0.637	0.2±0.577	0.200
Reflux	0.4±0.645	0.2±0.577	0.123
PPI			
No	21 (84)	23 (92)	0.352
Yes	2 (8)	2 (8)	
Intermittent	2 (8)	0	
Postoperative follow up at 6 months			
Dysphagia	0.16±0.374	0.6±1.0	0.119
Gas bloat	0.2±0.5	0.44±0.869	0.396
Heartburn	0.72±0.842	0.2±0.577	0.008*
Reflux	0.72±0.842	0.2±0.577	0.008*
PPI			
No	15 (60)	22 (88)	0.071
Yes	5 (20)	2 (8)	
Intermittent	5 (20)	1 (4)	
Postoperative follow up at 12 months			
Dysphagia	0	0.2±0.588	0.077
Gas bloat	0.125±0.337	0.166±0.48	0.957
Heartburn	1.08±0.9286	0.541±0.832	0.039*
Reflux	1±0.932	0.541±0.832	0.077
PPI			
No	9 (37.5)	16 (66.7)	0.123
Yes	10 (41.7)	5 (20.8)	
Intermittent	5 (20.8)	3 (12.5)	
Postoperative follow up at 18 months			
Dysphagia	0	0.16±0.48	0.077
Gas bloat	0	0.16±0.48	0.077
Heartburn	1.208±0.93	0.66±0.868	0.045*
Reflux	1.208±0.93	0.66±0.868	0.045*
PPI			
No	8 (33.3)	14 (58.3)	0.162
Yes	12 (50)	6 (25)	
Intermittent	4 (16.7)	4 (16.7)	

Table 4: Gastroesophageal reflux disease quality of life score and satisfaction at 12 months

	Toupet [<i>n</i> (%)]	Nissen [<i>n</i> (%)]	Test of significance
Satisfaction			
Satisfied	13 (52)	17 (68)	<i>P</i> =0.476
Neutral	4 (16)	2 (8)	
Unsatisfied	8 (32)	6 (24)	
GERD-QOL questionnaire score	9.208±7.046	5.95±5.59	<i>P</i> =0.059

GERD, gastroesophageal reflux disease; QOL, quality of life.

DISCUSSION

Many investigations have been conducted to find out the best surgical alternative to medical treatment of patients with GERD^[16]. Being safe, effective, and durable with minimal complications are the criteria of the ideal antireflux procedure^[17].

Except for some side effects such as dysphagia, gas bloat, and bowel syndrome, Nissen fundoplication is considered safe, effective, and durable^[18]. Toupet fundoplication is the most frequently used procedure alternative to Nissen^[19].

Many recent researches have shown a strong debate between Nissen and Toupet fundoplications, and the main attention was shifted from worry about the recurrence of reflux symptoms to postoperative side effects like dysphagia and gas bloat^[20–22].

The current prospective randomized study was conducted at Mansoura University Gastrointestinal Surgical Center, aiming to compare laparoscopic Nissen fundoplication and laparoscopic Toupet fundoplication, in terms of postoperative acid reflux control and postoperative complications, especially dysphagia and gas bloat on a short-term basis.

According to our findings, the incidence of postoperative dysphagia, as well as dysphagia scores, were higher in association with the Nissen procedure. That was evident throughout all scheduled follow-up visits. Nonetheless, it did reach a statistical significance only during the 3-month visit (*P*=0.022 and 0.008 for the incidence and score, respectively).

The reader could also notice that the incidence and severity of dysphagia decreased with time in both study groups. This can be explained by swelling and inflammation early due to surgical trauma^[23], then decrease the incidence of dysphagia due to healing and remodeling^[24].

Similar to our study, Lal *et al.*^[25] reported that no patients among the Toupet group had symptoms of

dysphagia, while about 20% (five patients) among the Nissen group had mild to moderate symptoms of dysphagia, and these symptoms relieved after 3–4 weeks after operations. These results had significant statistical differences (*P*=0.036).

Moreover, Qin *et al.*^[26] reported that patients in the Toupet group showed a low incidence of dysphagia during the early follow-up periods when compared with patients in the Nissen group, but this difference decreased significantly during follow-up periods.

According to Varin *et al.*^[27], who conducted a meta-analysis including 11 randomized controlled trials comparing the Nissen and Toupet methods, the incidence of dysphagia in the Nissen group had an odds ratio of 1.82–3.93 (*P*<0.001) which was higher than in the Toupet group.

In contrast to the previous findings, the incidence of dysphagia was similar after both procedures^[28,29].

Our findings revealed that the incidence and severity of both heartburn and reflux were significantly higher in association with the Toupet group than the Nissen group. That was evident from the 6-month follow-up until the end of the scheduled follow-up period.

Traditionally, the Nissen fundoplication procedure has been considered to provide a higher level of reflux control than the Toupet fundoplication. This is primarily due to the differences in the extent of the wrap created during each procedure^[30,31].

In agreement with our findings, Farrell *et al.*^[32] reported that heartburn and regurgitation were similarly improved in both groups 6 weeks after the operation. However, after 1 year, heartburn and regurgitation were re-emerging in Toupet patients compared to the Nissen.

On the other hand, a previous meta-analysis investigated the incidence of postoperative heartburn. Heartburn occurred in 6.45–60.29% of the population after Nissen fundoplication and 5.26–55.10% after

Toupet fundoplication. No significant statistically difference was found between the Nissen group and the Toupet group according to the prevalence of heartburn^[20]. Additionally, Shaw *et al.*^[29] also reported statistically comparable heartburn scores between the two procedures at 3-month and last follow-up visits ($P>0.05$).

According to the usage of PPI (Proton pump inhibitor), there was no significant statistically difference ($P>0.05$) between the two procedures in this current study. That coincides with Gunter *et al.*^[33], who reported that PPI medication administration was reported by 15.8, 59.6, and 70% of cases in the Toupet group, and 27.3, 41.7, and 37.7% of cases in the Nissen group, at 1, 3, and 5-year follow-up visits ($P>0.05$).

Moreover, Shaw *et al.*^[29] reported no statistically significant difference between Nissen and Toupet procedures in postoperative PPI use in their randomized trial ($P=0.55$), with an average of over 5 years of follow-up.

Our findings revealed that the incidence of gas bloat syndrome was significantly higher in association with the Nissen approach at 3-month follow-up ($P=0.0413$). However, that significance faded on subsequent follow-up visits ($P>0.05$).

It is believed that Nissen fundoplication has a high incidence of gas bloat when compared with the Toupet procedure due to the 360° wrap, which can create a higher degree of tightness and restrict the normal belching mechanism^[34] and decreased gastric capacity due to the complete wrap lead to reduce the capacity of the stomach to accommodate gas^[35].

Our findings were also confirmed by Wang *et al.*^[36], who noticed an increase in the same adverse event in the Nissen group at short-term follow-up (13 vs. 4% in the Toupet group – $P=0.02$).

Nonetheless, Shaw *et al.*^[29] reported that the gas bloat score had statistically comparable values at the short and long-term follow-up. In the short-term, it had mean values of 2.2 and 2.3, while it had mean values of 1.4 and 1.2 at the last follow-up in the Nissen and Toupet groups, respectively ($P>0.05$).

In the current study, according to QOL after one-year, there was no significant difference between the two procedures ($P=0.059$). Gunter *et al.*^[33] reported no significant differences in the measured QOL scores between the Toupet and Nissen groups after 1, 3, or 5 years following the procedure.

Our findings revealed no significant difference between the two procedures regarding patient

satisfaction ($P=0.476$). This means that all reported differences in reflux symptoms, dysphagia, and gas bloat between the patients of the two groups did not affect the patients' satisfaction and patients remained highly satisfied after both procedures.

The same findings were also reported by Gunter *et al.*^[33], who reported that the percentage of satisfied patients was 86.8, 74.5, and 70% after 1, 3, and 5 years in the Toupet group, compared to 87, 79.2, and 77.4% of cases in the Nissen group at the same follow-up visits, respectively ($P=1, 0.77, \text{ and } 0.67$, respectively).

Other two meta-analyses of randomized studies comparing Toupet fundoplication and Nissen fundoplication have reported similar satisfaction between the two techniques^[6,37].

Being a single-center study with a relatively small sample size and lacking a long-term follow-up is considered a limitation to our study, so these limitations should be considered in upcoming studies.

CONCLUSION

We found that Nissen fundoplication had a high incidence of dysphagia during early follow-up than Toupet, but this incidence decreased during follow-up periods to be near Toupet. Also Nissen fundoplication showed good control of heartburn and reflux during all follow up periods compared to Toupet. No significant difference was observed in the QOL questionnaire after 1 year of the procedure.

CONFLICT OF INTEREST

No conflict of interest.

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