

Comparison Study in Term of Reflux Recurrence Symptoms between Toupet and Nissen Fundoplication for Hiatal Hernia

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Abstract: Background: Hiatal hernia, a condition where a portion of the stomach prolapses through the diaphragmatic esophageal hiatus. Surgical interventions, including Toupet and Nissen fundoplication, are commonly employed to manage refractory GERD symptoms. Aim of the Study: This study aims to compare the efficacy of Toupet versus Nissen fundoplication in terms of reflux recurrence symptoms and patient satisfaction following hiatal hernia repair. Methodology: A retrospective cohort study was conducted at Iraqi Private Hospital from March 2021 to July 2023. The study included 206 patients with hiatal hernia and GERD who underwent laparoscopic hernia repair and fundoplication surgery. Patients were followed up for three years, and data were collected on demographic and clinical variables, symptom frequency, and severity using a Reflux Diagnostic Questionnaire (RDQ). Patient satisfaction and 24-hour esophageal pH monitoring were also assessed. Results: The study included 206 patients, with a mean age of 45.2 years. Among them, 54.4% underwent Nissen fundoplication, while 45.6% underwent Toupet fundoplication. Both surgical methods significantly reduced the frequency and severity of GERD-related symptoms. Nissen fundoplication showed better improvement in heartburn and regurgitation, while Toupet fundoplication resulted in better outcomes for dysphagia. Postoperative patient satisfaction was high for both procedures, with 51.8% of Nissen and 42.6% of Toupet patients reporting excellent satisfaction. Improvements in 24-hour pH monitoring parameters were significant in both groups, with Nissen showing slightly better results in some measures. Conclusions: Both Nissen and Toupet fundoplication are effective in reducing GERD symptoms and improving patient satisfaction after hiatal hernia repair. Nissen fundoplication offers better control of heartburn and regurgitation, while Toupet fundoplication is more beneficial for reducing postoperative dysphagia. Surgeons should consider individual patient characteristics and symptom profiles when selecting the appropriate surgical technique.

Keywords: Hiatal hernia, GERD, Nissen fundoplication, Toupet fundoplication.

BACKGROUND

A hiatal hernia occurs when a portion of the stomach prolapses through the diaphragmatic esophageal hiatus. Most hiatal hernias are asymptomatic and are discovered incidentally, but rarely, a life-threatening complication may present acutely (Dean, C. *et al.*, 2012).

Hiatal hernias are more common in Western countries. The frequency of hiatus hernia increases with age, from 10% in patients younger than 40 years to 70% in patients older than 70 years (Till, B. M. *et al.*, 2023).

Hiatal hernias are more common in women than in men. This might relate to the intra-abdominal forces exerted in pregnancy (Wilkerson, J. A. *et al.*, 2023).

Muscle weakness and loss of elasticity as people age is thought to predispose to hiatus hernia, based on the increasing prevalence in older people. With decreasing tissue elasticity, the gastric cardia may not return to its normal position below the diaphragmatic hiatus following a normal swallow. Loss of muscle tone around the diaphragmatic opening also may make it more patulous (Addo, A. *et al.*, 2021).

Pathophysiology

The esophagus passes through the diaphragmatic hiatus in the crural part of the diaphragm to reach the stomach. The diaphragmatic hiatus itself is approximately 2 cm in length and chiefly consists of musculotendinous slips of the right and left diaphragmatic crura arising from either side of the spine and passing around the esophagus before inserting into the central tendon of the diaphragm. The size of the hiatus is not fixed, but narrows whenever intraabdominal pressure rises, such as when lifting weights or coughing (Weber, C. *et al.*, 2011).

The lower esophageal sphincter (LES) is an area of smooth muscle approximately 2.5-4.5 cm in length. The upper part of the sphincter normally lies within the diaphragmatic hiatus, while the lower section normally is intraabdominal. At this level, the visceral peritoneum and the phrenoesophageal ligament cover the esophagus. The phrenoesophageal ligament is a fibrous layer of connective tissue arising from the crura, and it maintains the LES within the abdominal cavity. The A-ring is an indentation sometimes seen on barium studies, and it marks the upper part of the LES. Just below this is a slightly dilated part of the esophagus, forming the vestibule. A second ring, the B-ring, may be seen just distal to the vestibule,

and it approximates the Z-line or squamocolumnar junction. The presence of a B-ring confirms the diagnosis of a hiatal hernia. Occasionally, the B-ring also is called the Schatzki ring (Nurczyk, K. *et al.*, 2021). Any sudden increase in intra-abdominal pressure also acts on the portion of the LES below the diaphragm to increase the sphincter pressure. An acute angle, the angle of His, is formed between the cardia of the stomach and the distal esophagus and functions as a flap at the gastroesophageal junction and helps prevent reflux of gastric contents into the esophagus (Pawluszczyk, P. *et al.*, 2018).

The gastroesophageal junction acts as a barrier to prevent reflux of contents from the stomach into the esophagus by a combination of mechanisms forming the anti-reflux barrier. The components of this barrier include the diaphragmatic crura, the LES baseline pressure and intra-abdominal segment, and the angle of His. The presence of a hiatal hernia compromises this reflux barrier not

only in terms of reduced LES pressure but also reduced esophageal acid clearance. Patients with hiatal hernias also have longer transient LES relaxation episodes particularly at night time. These factors increase the esophageal mucosa acid contact time predisposing to esophagitis and related complications (Hyun, J. J. & Bak, Y. T. 2011).

Endoscopic and radiologic studies have demonstrated that 50% to 90% of patients with gastroesophageal reflux disease (GERD) have hiatal hernias. One current hypothesis suggests that hiatal hernia does not cause GERD, but rather impairs esophageal clearance of refluxed gastric acid and increases the chance for symptoms, esophagitis, or both. Researchers in this study sought to determine whether a hiatal hernia's effects on transient lower esophageal sphincter relaxation (t LESR) cause GERD (Herregods, T. V. *et al.*, 2015).

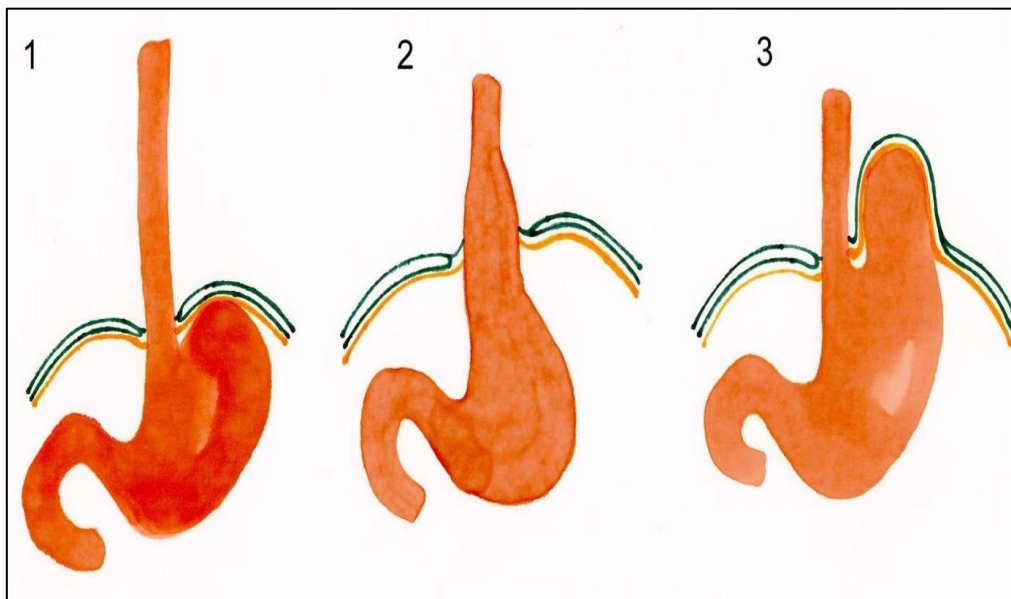


Figure 1: shows the normal relationship of the gastroesophageal (GE) junction, stomach, esophagus, and diaphragm. **2:** shows a sliding hiatal hernia, in which the cardia immediately below the GE junction is seen to prolapse through the diaphragmatic hiatus into the chest. **3:** shows a paraesophageal hernia in which the cardia or fundus of the stomach prolapses through the diaphragmatic hiatus, leaving the GE junction within the esophageal cavity (Fein, M. *et al.*, 1999).

Diagnosis

The typical reason for evaluation is the presence of symptoms of gastroesophageal reflux disease (GERD) or a chest radiograph suggesting a paraesophageal hernia.

A barium upper gastrointestinal series may yield the following findings:

- Outpouching of barium at the lower end of the esophagus

- A wide hiatus through which gastric folds are seen in continuum with those in the stomach
- Occasionally, free reflux of barium

A barium study also helps distinguish a sliding from a paraesophageal hernia (Kahrilas, P. J. *et al.*, 2008).

Upper GI endoscopy may be performed for the following purposes:

- To diagnose hiatal hernia (though this is actually incidental)
- To diagnose complications such as erosive esophagitis (edema, rings, exudates, furrows, and stenosis), ulcers in the hiatal hernia, Barrett esophagus, or tumor
- To permit biopsy of any abnormal or suspicious area (Siegal, S. R. *et al.*, 2017)
- **Esophageal Manometer** : This technique provides critical information about esophageal motility. A separation of 2 cm or more between the crural diaphragm and the lower esophageal sphincter (LES) is considered diagnostic for hiatal hernia (HH). Andolfi, *et al.*, recommend esophageal manometry, particularly pre-operative, to exclude achalasia and other motility disorders. High-resolution manometry (HRM) is essential for verifying esophageal peristalsis before fundoplication surgery, as it offers real-time pressure recordings.
- **24-hour pH Testing**: While not required for diagnosing hiatal hernia, this test is useful for quantitatively analyzing reflux episodes by correlating pH levels with reflux symptoms. Duranceau, *et al.*, regard it as the gold standard for documenting acid exposure in the esophageal lumen.
- **Computed Tomography (CT)with oral contrast**: Although it's not routinely required for diagnosis, CT scans can provide extra data about the location and type of hiatal hernia. Often, hiatal hernias are incidentally visualized during CT scans conducted for other reasons. Dallemagne, *et al.*, suggest using CT to exclude complications such as perforation, pneumoperitoneum, or pneumomediastinum. CT is particularly useful for evaluating gastric volvulus in patients with PEH.

Management

When symptoms are due to GERD, treatment goals include the following:

- Prevention of reflux of gastric contents
- Improved esophageal clearance
- Reduction in acid production

In the majority of patients, these goals are achieved by means of a combination of the following:

- Modifying lifestyle factors
- Neutralizing acid or inhibiting acid-producing mechanisms
- Enhancing esophageal and gastric clearance

If iron-deficiency anemia occurs, it usually responds well to proton-pump inhibitor (PPI) therapy (Roman, S. & Kahrilas, P. J. 2014).

Surgical treatment involves removing the hernia sac and closing the abnormally wide esophageal hiatus. It is necessary only in the very few patients who have complications of GERD despite aggressive PPI treatment. Potential surgical candidates include the following:

- Young patients with severe or recurrent complications of GERD (eg, strictures, ulcers, or bleeding) who cannot afford lifelong PPI treatment or prefer to avoid long-term pharmacotherapy
- Patients with pulmonary complications (e.g., asthma, recurrent aspiration pneumonia, chronic cough, or hoarseness linked to reflux disease) (Sfara, A. & Dumitrascu, D. L. 2019).

Three major types of surgical procedures correct gastroesophageal reflux and repair the hernia in the process. They can be performed by open laparotomy or with laparoscopic approaches, which currently are being employed more frequently. These procedures offer relief of symptoms in 80-90% of patients. In most cases, the procedure of choice is the one with which the surgeon is most familiar. These procedures carry low mortality and morbidity rates, lower than 15-20% (Braghetto, I. *et al.*, 2013).

Laparoscopic repair has good postoperative results with low mortality and morbidity rate. Additional preferences of laparoscopy include shorter hospital stays, less postoperative pain and better cosmetic results. Nowadays

laparoscopy is the preferred approach for most hiatal hernia repairs (Sivacolundhu, R. K. *et al.*, 2002) The three major types of surgical procedures that may be considered are as follows:

- Total fundoplication (or a variant, the Partial procedure) Belsey fundoplication (left posterolateral thoracotomy. The goal is to return the "high-pressure zone" of the cardia, otherwise known as the lower gastroesophageal sphincter (LES) to its normal anatomical position below the diaphragm)
- Hill repair (procedure consisting of calibration of the lower esophageal sphincter and posterior fixation of the gastroesophageal junction to the median arcuate ligament

Fundoplication is the procedure of creating a wrap with gastric fundus around the esophagus to make

a one-way valve, that allows food passage to the stomach but does not allow reflux coming up to the esophagus. Fundoplication is an important part of the operation that improves the quality of life after surgery and decreases GERD symptoms (Li, Z. T. *et al.*, 2019). There are three main methods of fundoplication:

- posterior 360°—Nissen • posterior 270°—Toupet
- anterior 180°—Dor.

Posterior 360° fundoplication (Total fundoplication) is the most widely used type. To achieve a complete fundoplication and wrap the fundus around the esophagus, the division of the short gastric arteries is performed. A mobilized part of the fundus is drawn posterior to the esophagus toward the right, so that it completely wraps around the esophagus and meets the left part of the fundus anteriorly. Both parts of the fundus are stitched together and also attached to the anterior wall of the esophagus with 3 permanent stitches. The length of complete fundoplication is about 2–3 cm. The 52-French bougie is placed in the esophagus during fundoplication, so that the wrap should not be too tight (Jamieson, G. G. *et al.*, 1994). Toupet fundoplication (posterior 270°) is a partial posterior fundoplication. The initial steps of this procedure are similar to Nissen fundoplication, with the difference being that fundus fixation is performed using stitches to the

right and left walls of the esophagus, leaving the anterior wall free and creating a 270° wrap. For this method, usually 6 stitches are necessary (3 on each side) (Bona, D. *et al.*, 2020).

Dor fundoplication (anterior 180°) is a partial anterior fundoplication. The initial steps are similar to posterior fundoplication, but mobilized fundus is wrapped anteriorly from the esophagus and fixed with stitches to the left and right walls of the esophagus. Anterior fundoplication is less physiological than posterior, because the Hiss angle is not created (DeMeester, S. R. 2020).

Both posterior fundoplication (Nissen and Toupet) has better long-term GERD symptom control than anterior fundoplication (Dor), Dysphagia is the most common postoperative complication after fundoplication. Usually, it is transient and resolves after 3 months. In some studies, the incidence of dysphagia after Nissen fundoplication is as high as 70% (Su, F. *et al.*, 2016).

Toupet fundoplication has less postoperative dysphagia when compared to Nissen fundoplication. Another common complaint after fundoplication is inability to belch or vomit, including excess flatulence and abdominal bloating. These complaints were found in up to 60% of the patients and did not depend on type of fundoplication (Andolfi, C. *et al.*, 2017)

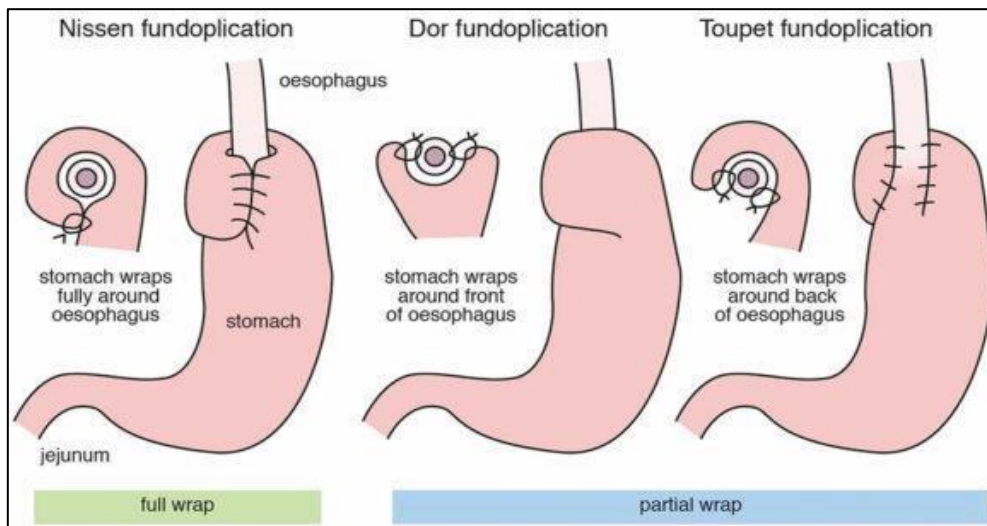


Figure 2.: the three main methods of fundoplication (Polk Jr, H. C. & Zeppa, R. 1971)

AIM OF THE STUDY

This study aims to compare the efficacy of Toupet versus Nissen fundoplication in terms of reflux recurrence symptoms and patient satisfaction following hiatal hernia repair.

Study Design: Retrospective Cohort Study

Methodology: This study was conducted from March 2021 to July 2023 at Iraqi private hospital in Najaf. Approval for the research proposal was obtained from the Arabic Board of Health Specialization, the local council of general surgery at Al-Najaf Teaching Center.

The study included 206 patients with hiatal hernia associated with gastroesophageal reflux disease (GERD) treated with laparoscopic hernia repair and fundoplication surgery. Patients were followed up for three years with regular visits to monitor disease recurrence.

Inclusion Criteria:

1. Patients diagnosed with hiatal hernia with reflux symptoms (typical and atypical) who had No response symptoms despite maximum dose of daily use of proton-pump inhibitors for at least three months before surgery.
2. Patients who underwent laparoscopic surgery for hiatal hernia repair and fundoplication.

Exclusion Criteria:

1. History of previous Bariatric surgery.
2. Patients with achalasia, Zollinger-Ellison syndrome, or malignant tumors.
3. Loss of follow-up and no response to phone calls
4. Pediatric age group.
5. Pregnant women.

Data Collection

Data were retrospectively collected from hospital databases, a prepared questionnaire was filled out for each patient, containing demographic variables (age, gender, BMI, residency) and clinical variables (hernia type, previous investigations).

Hiatal hernia was classified according to international standards into four types (Kim, P. *et al.*, 2021).

1. Type I (sliding).
2. Type II (pure paraesophageal).
3. Type III (mixed).
4. Type IV (mixed with other organs).

Surgical Procedures

Patients were advised to stop smoking for at least four weeks before surgery and to discontinue blood-thinning medications for one week. Preoperative preparation included basic investigations: CBC, viral screen, renal function test (RFT), random blood sugar, general urine examination (GUE), and liver function tests, CXR. Diagnostic evaluation involved endoscopy, barium sulfate swallow or meal radiology, and esophageal manometry.

GERD was diagnosed based on typical heartburn and regurgitation, endoscopic evidence of esophagitis, and the patients were operated with endoscopic hernia repair.

During surgery, patients were sedated and placed in a reverse-Trendelenburg position. A Veress needle was inserted at palmer point to create a pneumoperitoneum, followed by the insertion of a primary 10-mm trocar at the upper edge of the navel. Four additional trocars were placed under direct visualization.

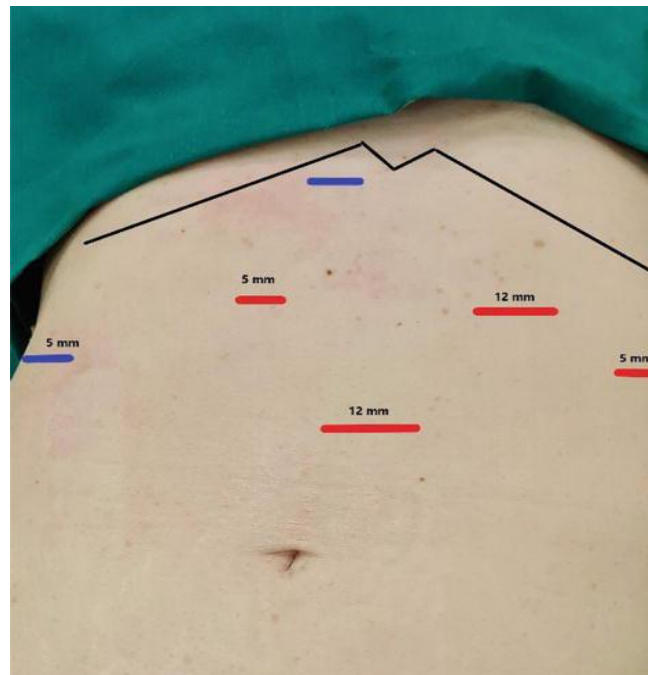


Figure 3: Show ports site during laparoscopic hiatal hernia repair.

The liver was retracted, the esophageal hiatus was exposed, and the hernia sac was dissected and reduced from the mediastinum.

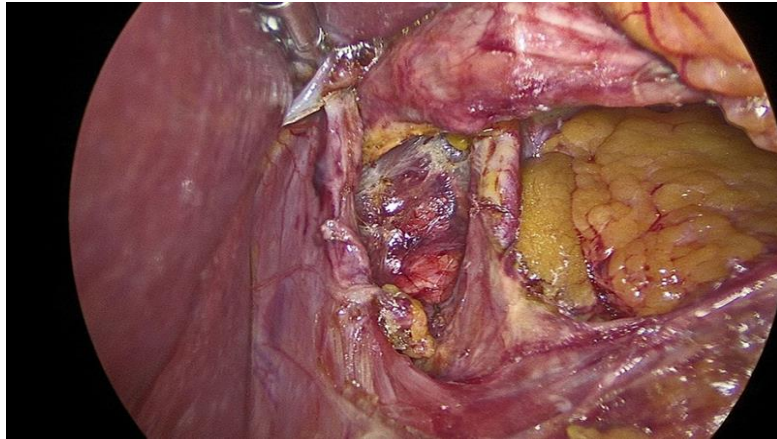


Figure 4: show circumferential mobilization of the hernia sac

A 3-4 cm esophageal repositioning was performed, and the diaphragmatic crurae were sutured to reduce the esophageal hiatus. In cases of large

hernial sacs (>5 cm), a polypropylene mesh patch was fixed around the esophagus.

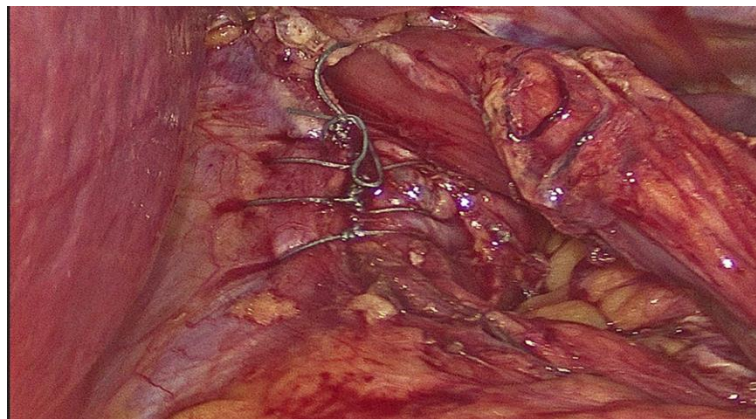


Figure 5: Show hiatal hernia orifice after Cruroplasty

For 360-degree Nissen fundoplication, a full-circle valve was formed from the posterior and anterior

aspects of the fundus and sutured together using three separate nonabsorbable 2-0 sutures.

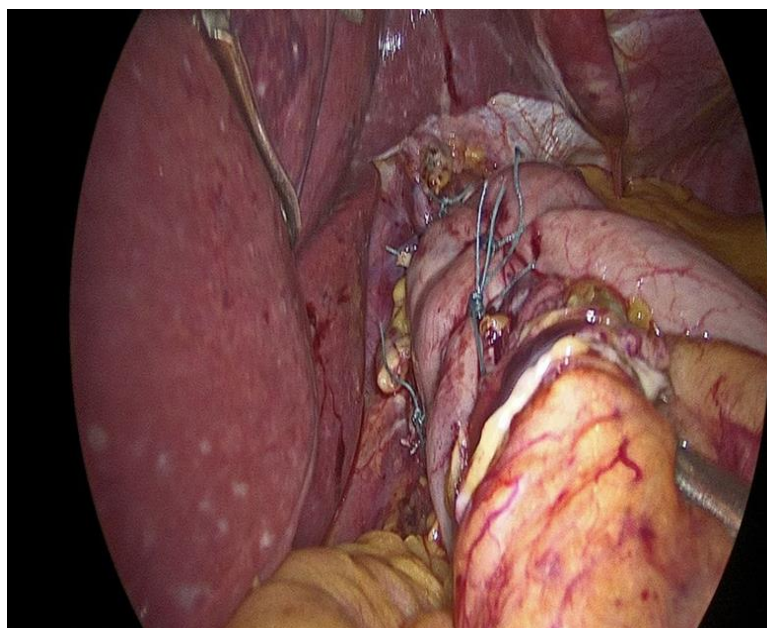


Figure 6: Show 360° Nissen fundoplication

If Toupet fundoplication was performed, a partial 270-degree wrap was created around the posterior aspect of the esophagus. This involved suturing the fundus to the esophagus and crura with interrupted nonabsorbable sutures, ensuring a loose wrap to

prevent postoperative dysphagia. The anterior aspect of the fundus was left unattached, allowing for reduced pressure on the esophagus and minimizing the risk of complications.

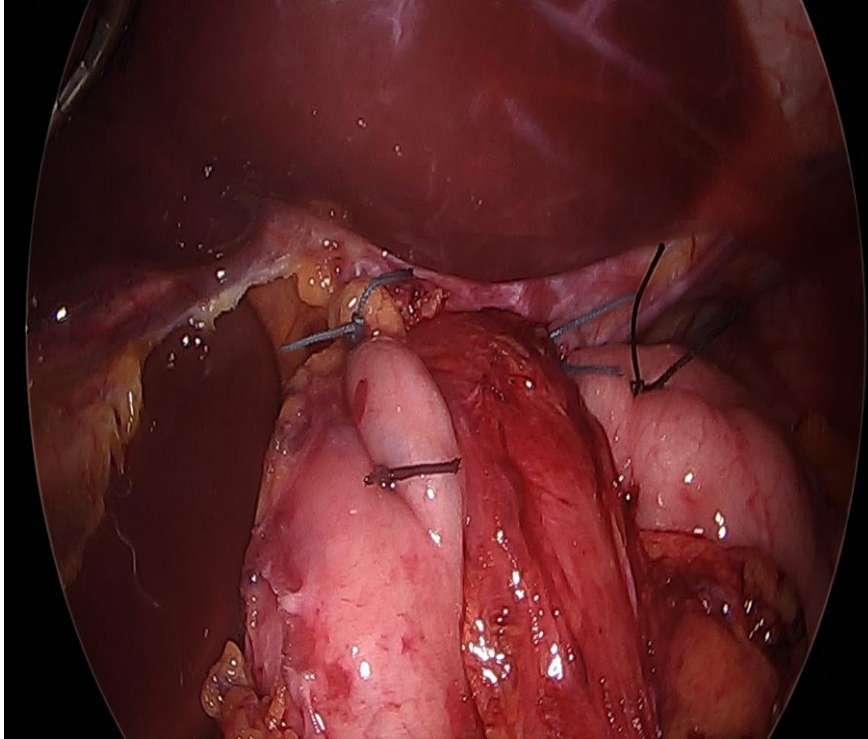


Figure 7: Show 270° Toupet fundoplication

Postoperative Evaluation

Postoperative follow-up included 24-hour esophageal pH monitoring at six months, and symptoms frequency at one year after surgery symptom frequency and severity were graded using a 6-point Reflux Diagnostic Questionnaire (RDQ): (Bolier, E. A. *et al.*, 2015)

- 0: None
- 1: Less than once per week
- 2: Once or twice per week
- 3: Three or four times per week
- 4: Five or six times per week
- 5: More than six times per week

Severity of Symptoms was graded as the following (Fuchs, K. H. *et al.*, 2021):

- 0: None
- 1: Slight
- 2: Mild
- 3: Moderate
- 4: Severe
- 5: Extremely severe

The sum of the frequency score and the severity score was designated as the symptom score, Patient satisfaction with surgery results was assessed as follows:

- Excellent: Complete resolution of symptoms
- Good: Symptoms occurring once per month or less frequently
- Fair: Symptoms occurring weekly or less frequently
- Poor: Symptoms occurring daily or more often, or as severe as those prior to surgery

Data from each patient questionnaire is transformed into a Microsoft excel format sheet and then sent for statistical analysis.

ETHICAL CONSIDERATIONS

The study was approved by the Arabic Board Committee at Najaf Educational Center and the Iraqi Private Hospital. Informed consent was obtained from all patients, explaining the research objectives, data confidentiality, surgical procedures, potential complications, and benefits.

STATISTICAL ANALYSIS:

Analysis of data was carried out using the available statistical package of IBM SPSS version 28 for Microsoft Windows, Data were presented in simple measures of frequency, percentage, mean, standard deviation, and range (minimum-maximum values).

The significance of difference of different means (quantitative data) were tested using Students-t-test for difference between two independent means or Paired-t-test for difference of paired observations (or two dependent means), chi-square test was used to test the difference between two categorical variables.

Statistical significance was considered whenever the P value was equal or less than 0.05.

RESULTS

The study included 206 patients with a mean age of 45.2 ± 12.3 years, and an age range spanning from 18 to 75 years. The patients were divided into four age groups: 17.0% of the patients were aged

between 18-30 years, 34.0% were aged between 31-45 years, 31.6% were aged between 46-60 years, and 17.5% were aged between 61-75 years. Gender distribution was slightly higher towards females, who constituted 55.3% of the total, while males made up the remaining 44.7%. The mean BMI of the patients was 28.5 ± 4.7 kg/m². The BMI categories were as follows: 2.9% of the patients were underweight (BMI <18.5), 33.1% had normal weight (BMI 18.5-24.9), 38.8% were overweight (BMI 25-29.9), and 25.2% were classified as obese (BMI ≥ 30).

Regarding residency, a larger proportion of the patients, 63.1%, resided in urban areas, while the remaining 36.9% lived in rural areas. The patients were also categorized by the type of surgery they underwent: 112 patients (54.4%) underwent Nissen surgery, while 94 patients (45.6%) underwent Toupet surgery.

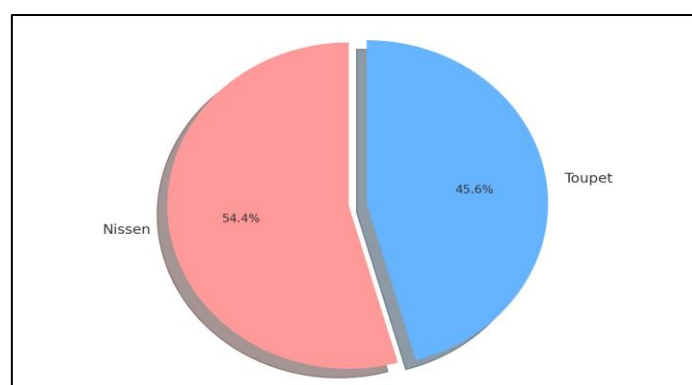


Figure 8: the type of fundoplication after hiatal hernia repair among the study sample patients (n=206)

Table 1: Demographic Characteristics of the Study Sample Patients

Characteristic	Nissen (n=112)	Toupet (n=94)	Total (n=206)
Age mean \pm SD (years)	45.2 ± 12.3	45.2 ± 12.3	45.2 ± 12.3
(range) (years)	(18-75)	(18-75)	(18-75)
Age Group (years)	N (%)	N (%)	N (%)
18-30	19 (17.0%)	16 (17.0%)	35 (17.0%)
31-45	38 (34.0%)	32 (34.0%)	70 (34.0%)
46-60	35 (31.6%)	30 (31.9%)	65 (31.6%)
61-75	20 (17.9%)	16 (17.0%)	36 (17.5%)
Total N	112	94	206
Gender	N (%)	N (%)	N (%)
Female	62 (55.4%)	52 (55.3%)	114 (55.3%)
Male	50 (44.6%)	42 (44.7%)	92 (44.7%)
Total N	112	94	206
BMI mean \pm SD (kg/m ²)	28.5 ± 4.7	28.5 ± 4.7	28.5 ± 4.7
BMI Category (kg/m ²)	N (%)	N (%)	N (%)
Underweight (<18.5)	3 (2.7%)	3 (3.2%)	6 (2.9%)
Normal weight (18.5-24.9)	38 (33.9%)	30 (31.9%)	68 (33.1%)
Overweight (25-29.9)	45 (40.2%)	35 (37.2%)	80 (38.8%)

Obesity (≥ 30)	26 (23.2%)	26 (27.7%)	52 (25.2%)
total	112	94	206
Residency	N (%)	N (%)	N (%)
Urban	70 (62.5%)	60 (63.8%)	130 (63.1%)
Rural	42 (37.5%)	34 (36.2%)	76 (36.9%)
total	112	94	206

The clinical characteristics and preoperative symptoms of the study sample reveal that the types of hernia among the patients were distributed as follows:

38.8% had Type I hernia, 24.3% had Type II hernia, 29.1% had Type III hernia, and 7.8% had Type IV hernia. Regarding preoperative symptoms of GERD, 72.8% of the patients experienced typical symptoms, while 27.2% had atypical

symptoms. Diagnostic tests showed that all patients (100%) underwent endoscopy, 87.4% underwent a barium swallow or meal test, and 72.8% had esophageal manometry. The prevalence of symptoms among the patients was high: 87.4% experienced heartburn, 77.7% had regurgitation, 43.7% had chest pain, and 34.0% experienced dysphagia.

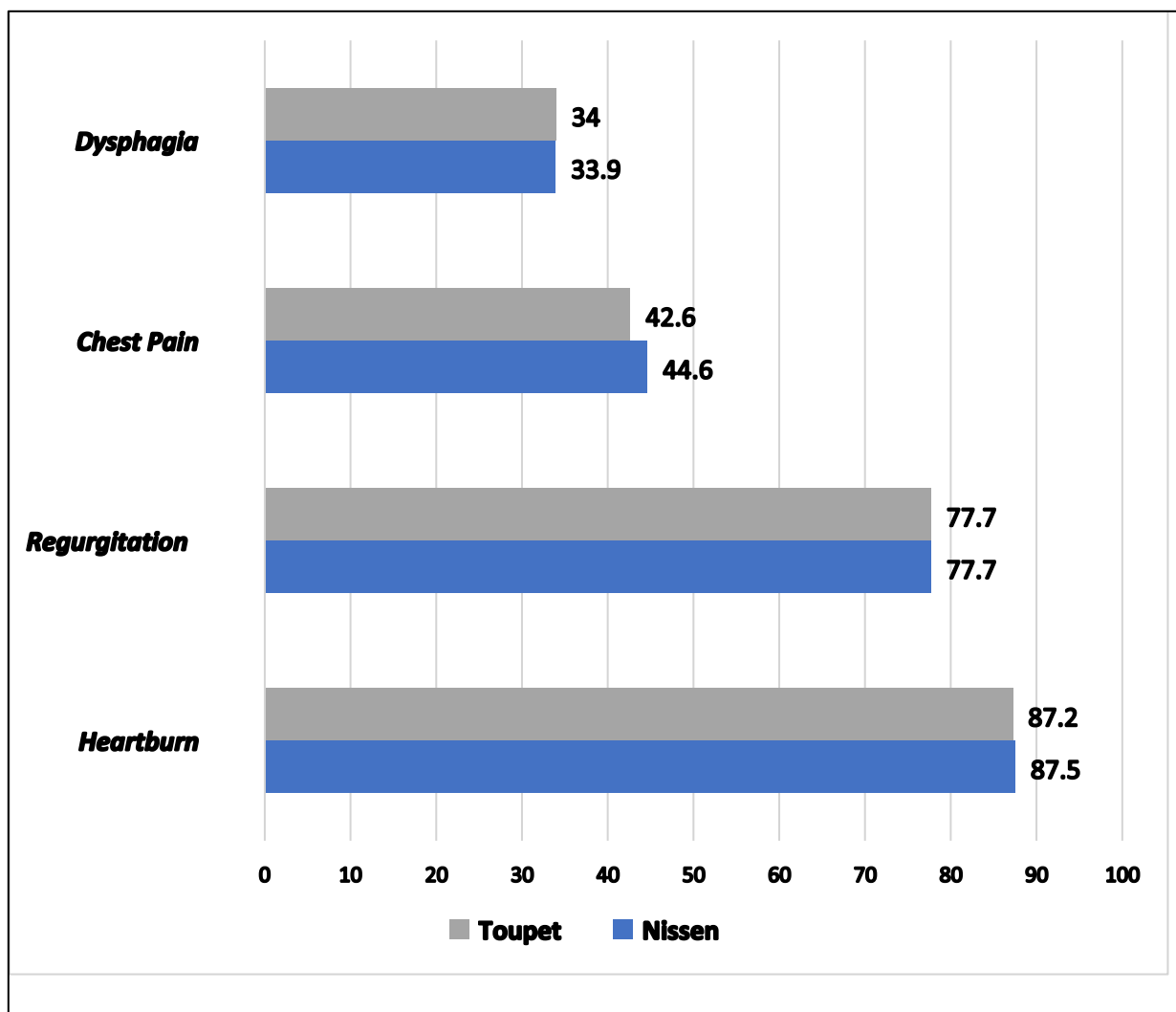


Figure 9: percentage of symptoms among the study sample patients

Table 2: Clinical Characteristics and Preoperative Symptoms of the Patients.

Characteristic	Nissen (n=112)	Toupet (n=94)	Total (n=206)
Type of Hernia	N (%)	N (%)	N (%)
Type I	44 (39.3%)	36 (38.3%)	80 (38.8%)
Type II	27 (24.1%)	23 (24.5%)	50 (24.3%)

Type III	32 (28.6%)	28 (29.8%)	60 (29.1%)
Type IV	9 (8.0%)	7 (7.4%)	16 (7.8%)
Preoperative Symptoms of GERD	N (%)	N (%)	N (%)
Typical	82 (73.2%)	68 (72.3%)	150 (72.8%)
Atypical	30 (26.8%)	26 (27.7%)	56 (27.2%)
Diagnostic Tests	N (%)	N (%)	N (%)
Endoscopy	112 (100%)	94 (100%)	206 (100%)
Barium Swallow or meal	98 (87.5%)	82 (87.2%)	180 (87.4%)
Esophageal Manometry	82 (73.2%)	68 (72.3%)	150 (72.8%)
Symptoms	N (%)	N (%)	N (%)
Heartburn	98 (87.5%)	82 (87.2%)	180 (87.4%)
Regurgitation	87 (77.7%)	73 (77.7%)	160 (77.7%)
Chest Pain	50 (44.6%)	40 (42.6%)	90 (43.7%)
Dysphagia	38 (33.9%)	32 (34.0%)	70 (34.0%)

After hiatal hernia repair and Nissen fundoplication surgery, the frequency of heartburn decreased significantly from 87% preoperatively to 12% postoperatively ($p < 0.001$). Regurgitation dropped from 77% to 15% ($p = 0.007$), chest pain from 44% to 10% ($p = 0.009$), and dysphagia from 34% to 20% ($p = 0.026$). For Toupet surgery, heartburn decreased from 85% preoperatively to 18% postoperatively ($p = 0.006$), regurgitation from 75% to 20% ($p = 0.013$), chest pain from 42% to

12% ($p = 0.012$), and dysphagia from 35% to 12% ($p < 0.001$).

Both Nissen and Toupet surgeries significantly reduced the frequency of GERD-related symptoms. The reduction were more pronounced in heartburn and regurgitation with Nissen fundoplication, while Toupet fundoplication resulted in better dysphagia.

Table 3: Symptom Frequency Comparison between Preoperative and Postoperative Using Nissen and Toupet Surgeries

Symptom	Nissen Preoperative (%)	Nissen Postoperative (%)	P Value (Nissen)	Toupet Preoperative (%)	Toupet Postoperative (%)
Heartburn	87	12	<0.001	85	18
Regurgitation	77	15	0.007	75	20
Chest Pain	44	10	0.009	42	12
Dysphagia	34	20	0.026	35	12

* a patient may have one or more symptom.

For Nissen surgery, the frequency of symptoms categorized as "None" increased from 10.8% preoperatively to 44.6% postoperatively, For Toupet surgery, the frequency of symptoms categorized as "None" increased from 11.7% preoperatively to 34% postoperatively, other symptom frequency categories also showed a

significant reduction postoperatively in both types of surgeries.

P values of the difference was statistically significant for both modalities however, patients that had the Nissen fundoplication demonstration more significant changes after the surgery (Table 3.)

Table 4: Symptom Frequency Comparison before and after surgery

Symptom Frequency	Nissen Preop. n (%)	Nissen Postop. n (%)	P Value Nissen	Toupet Preop. n (%)	Toupet Postop. n (%)	P Value Toupet
None	12 (10.8%)	50 (44.6%)	<0.001	11 (11.7%)	32 (34%)	<0.001
<1/week	20 (17.8%)	31 (27.7%)	<0.001	20 (21.3%)	25 (26.7%)	0.01
1-2 /week	24 (21.4%)	16 (14.2%)	0.03	21 (22.4%)	24 (25.5%)	0.05
3-4/week	30 (26.8%)	9 (8.1%)	0.001	22 (23.4%)	10 (10.6%)	0.02
5-6/week	16 (14.2%)	4 (3.6%)	0.01	12 (12.7%)	2 (2.1%)	0.03
>6/week	10 (9%)	2 (1.8)	0.03	8 (8.5%)	1 (1.1%)	0.04

total	112	112		94	94	
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Both Nissen and Toupet surgeries also significantly reduced the severity of GERD-related symptoms. The percentage of patients experiencing no symptoms postoperatively increased notably, especially in the Nissen group, the difference between both surgeries was statistically not significant.

Comparing the changes in symptom severity between both modalities was not significant with P values above 0.05, despite that both surgeries reduced the incidence and severity of symptoms as showed in table 4., the difference in reduction was not significant towards a specific operation type.

This highlights the effectiveness of both surgical procedures in alleviating symptom severity

Table 5: Symptom Severity Comparison Between Nissen and Toupet Surgeries

Symptom Severity	Nissen Preop. n (%)	Nissen Postop. n (%)	Toupet Pre op. n (%)	Toupet Post op. n (%)	P Value
None	8 (7.1%)	44 (39.3%)	6 (6.3%)	29 (30.9%)	0.072
Slight	14 (12.5%)	37 (33%)	11 (11.7%)	25 (26.7%)	0.081
Mild	20 (17.9%)	14 (12.3%)	22 (23.4%)	20 (21.3%)	0.177
Moderate	28 (25%)	10 (8.9%)	21 (22.3%)	14 (14.8%)	0.337
Severe	30 (26.8%)	6 (5.6%)	25 (26.7%)	4 (4.2%)	0.129
Extremely Severe	12 (10.7%)	1 (0.9%)	9 (9.6%)	2 (2.1%)	0.04
total	112	112	94	94	

Comparing both surgeries in terms of patient’s satisfaction after Nissen surgery, 51.8% of patients reported excellent satisfaction, while 42.6% of Toupet surgery patients reported the same, good satisfaction was reported by 32.2% of Nissen patients and 37.2% of Toupet patients, Fair satisfaction was reported by 14.3% of Nissen patients and 15.9% of Toupet patients, Poor

satisfaction was reported by 1.7% of Nissen patients and 4.3% of Toupet patients.

P value were above the significant level of 0.05 indicating that both modalities of fundoplication with hiatal hernia repair resulted in the same profile of patients’ satisfaction after one year of follow up.

Table 6: Patient Satisfaction Comparison Between Nissen and Toupet Surgeries

Satisfaction Level	Nissen Postoperative n (%)	Toupet Postoperative n (%)	P Value
Excellent	58 (51.8%)	40 (42.6%)	0.137
Good	36 (32.2%)	35 (37.2%)	0.104
Fair	16 (14.3%)	15 (15.9%)	0.261
Poor	2 (1.7%)	4 (4.3%)	0.773
total	112	94	

Both surgical methods significantly reduced the total percentage of time that the pH was less than 4, Nissen surgery showed a reduction from 10.2% preoperatively to 1.5% postoperatively, while Toupet surgery showed a reduction from 9.8% to 2.0%, Upright % time pH <4 show similar reductions with Nissen fundoplication surgeries reducing from 12.5% to 1.8% and Toupet surgeries reducing from 12.0% to 2.3%.

In the supine position, Nissen surgery reduced the percentage from 8.0% to 1.2%, and Toupet surgery reduced it from 7.5% to 1.5%.

Regarding the number of reflux episodes both surgeries significantly reduced the number of reflux episodes, with Nissen showing a reduction from 45 to 6 episodes and Toupet showing a reduction from 42 to 8 episodes.

Both surgeries also reduced the number of prolonged reflux episodes >5 min., with Nissen

reducing from 8 to 1 and Toupet reducing from 7 to 1, The duration of the longest reflux episode decreased from 18 to 4 minutes in the Nissen group and from 17 to 5 minutes in the Toupet group.

Overall, both Nissen and Toupet surgeries effectively improved the parameters of 24-hour pH monitoring, with Nissen showing slightly better results in some measures.

Table 7: 24-Hour pH Monitoring Comparison Between Nissen and Toupet Surgeries

Measurement	Nissen Preoperative (mean ± SD)	Nissen Postoperative (mean ± SD)	Toupet Preoperative (mean ± SD)	Toupet Postoperative (mean ± SD)
Total % time pH <4	10.2 ± 2.3	1.5 ± 0.6	9.8 ± 2.1	2.0 ± 0.7
Upright % time pH <4	12.5 ± 3.1	1.8 ± 0.5	12.0 ± 3.0	2.3 ± 0.6
Supine % time pH <4	8.0 ± 1.9	1.2 ± 0.4	7.5 ± 1.7	1.5 ± 0.5
Number of reflux episodes per 24_hour	45 ± 10	6 ± 2	42 ± 9	8 ± 3
Number of reflux episodes >5 min per 24_hour	8 ± 2	1 ± 0.5	7 ± 2	1 ± 0.5
Longest reflux episode (min)	18 ± 5	4 ± 1	17 ± 4	5 ± 1

The current study results show that the mean age of the study sample was 45.2 years, ranging 18-75 years with Most patients fall into the 31-45 years category (34%) and slightly more females (55.3%) than males (44.7%) and majority of patients are overweight (38.8%) or obese (24.8%).

This aligns with recent findings. According to a study by (Li, et al., 2023) the mean age of patients undergoing laparoscopic fundoplication was also around the mid-40s, and females constituted a slightly higher percentage, around 54%.

The BMI distribution aligns with the findings of a study by (Rausa, et al., 2023) which reported similar BMI distributions in GERD patients undergoing laparoscopic fundoplication, with high percentages of patients being classified as overweight or obese.

Our study results show that Type I hernia is the most common (38.8%), followed by Type III (29.1%) with Typical GERD symptoms are prevalent (72.8%), heartburn (87.4%), regurgitation (77.7%), chest pain (43.7%), and dysphagia (34.0%).

A study by (Aiolfi, et al., 2023) found similar distributions with Type I 35-40% and typical symptoms present in more than 75% of the patients, the prevalence of symptoms align with the results of other studies, in comparison with (Beck, et al., 2009) they reported heartburn: 91%, regurgitation: 73%, chest pain: 40% and dysphagia 35%.

The current study results showed significant reduction in heartburn, regurgitation, chest pain, and dysphagia postoperatively with Nissen fundoplication showing better heartburn and

regurgitation improvements and Toupet fundoplication show better dysphagia improvement.

A study by (Stefanidis, et al., 2009) reported similar findings, where both Nissen and Toupet fundoplication effectively reduced GERD symptoms. Their meta-analysis indicated that Nissen fundoplication had a slight advantage in controlling acid reflux compared to Toupet fundoplication.

On the other hand, another study by (VARIN, et al., 2009) have concluded that Total fundoplication (Nissen) led to a notably higher occurrence of postoperative dysphagia (P < 0.001), bloating (P = 0.02), and flatulence (P < .001). However, there were no significant differences observed in the incidence of esophagitis (P = 0.33), heartburn (P = 0.58), or persistent acid reflux (P = 0.45).

(Li, et al., 2023) also concluded that both Nissen and Toupet fundoplications significantly reduce GERD symptoms, with no major differences in long-term outcomes. However, Nissen fundoplication showed a slightly higher reduction in heartburn and regurgitation, while Toupet fundoplication resulted in better outcomes for dysphagia due to its partial wrap, which is less restrictive.

Another study by (McKinley, et al., 2021) reported similar findings, emphasizing that both surgical methods are effective in reducing symptom severity. They noted that Nissen fundoplication is associated with a higher rate of postoperative dysphagia compared to Toupet fundoplication.

Our study reports postoperative patient satisfaction rates after Nissen fundoplication as Excellent:

51.8%, Good: 32.2%, Fair: 14.3% and Poor: 1.7%, as for Toupet fundoplication as Excellent: 42.6%, Good: 37.2%, Fair: 15.9% and Poor: 4.3%

(Fibbe, *et al.*, 2001) found that patient satisfaction rates post-fundoplication surgeries were high, with Nissen fundoplication showing a slight edge in overall patient satisfaction. The study reported: Very Satisfied/Satisfied: 90%, Neutral/Dissatisfied: 10% while for Toupet Fundoplication: Very Satisfied/Satisfied: 85% and Neutral/Dissatisfied: 15% which is compare with our findings.

(Rudolph-Stringer, *et al.*, 2022) also examined long-term patient satisfaction over 20 years after complete Nissen versus anterior 180-degree partial fundoplication and found that satisfaction levels were generally high for both procedures, with a slight preference for Nissen fundoplication in terms of long-term symptom relief.

The current results this study reports significant improvements in 24hour pH monitoring parameters for both Nissen and Toupet fundoplication surgeries, similarly other studies confirm that both Nissen and Toupet fundoplications are effective in significantly improving 24-hour pH monitoring parameters. Nissen fundoplication tends to have a slight edge in reducing the number and duration of reflux episodes, while Toupet fundoplication shows similar improvements, particularly beneficial for patients with esophageal motility issues.

(Lee Y, *et al.*, 2023) conducted databases analysis of than included 13 randomized control trails comparing different types of fundoplications reporting long-term (> 5 years) outcomes, with 2063 patients across Nissen (360°), Dor (anterior 180°–200°), and Toupet (posterior 270°) fundoplications they concluded that Toupet had lower incidence of dysphagia compared to Nissen, there was no difference in dysphagia between Toupet and Dor or between Dor and Nissen.

(Tian, *et al.*, 2015) also performed another meta-analysis on different randomized control trials involving 814 patients (52.05%) who underwent laparoscopic Nissen fundoplication and 750 patients (47.95%) who underwent laparoscopic Toupet fundoplication and their results show that the rates of adverse outcomes, including dysphagia, gas-bloat syndrome, inability to belch, and re-operation due to severe dysphagia, were significantly higher after laparoscopic Nissen fundoplication (LNF), LNF was associated with a

significantly higher incidence of postoperative dysphagia.

(Andreou A, *et al.*, 2020) study that was based on 29 randomized trials which included 1892 patients also reported that laparoscopic toupet 270° fundoplication generally yields better results than 360° total fundoplication, particularly in reducing postoperative dysphagia. However, other forms of partial fundoplication may be just as effective. The rates of regurgitation, morbidity, and reoperation were comparable among the different treatments, although the evidence supporting these findings is of very low quality.

STUDY LIMITATIONS

1. The study's retrospective design that may introduce biases related to data collection and patient recall and loss of previous investigations, Data were collected retrospectively from hospital databases and patients after surgery, which may be subject to errors or missing information
2. Conducting the study at a single place may limit the generalizability of the findings and the study population may not represent a diverse ethnic or demographic group.
3. Lack of comparison with other treatment modalities that are available like non-surgical treatment or alternative surgical interventions.
4. The assessment of symptom frequency and severity relied on patient self-reporting, which can be subjective and influenced by individual perception.

CONCLUSIONS

1. Effectiveness of Laparoscopic Surgery: The study demonstrates that laparoscopic hernia repair combined with fundoplication (both Nissen and Toupet) is effective in treating hiatal hernia and gastroesophageal reflux disease (GERD). Both surgical techniques significantly reduced the frequency and severity of GERD-related symptoms.
2. Symptom Reduction: Postoperative outcomes show a substantial decrease in the prevalence of heartburn, regurgitation, chest pain, and dysphagia in patients undergoing both Nissen and Toupet fundoplication surgeries. The reduction in symptoms was statistically significant, highlighting the efficacy of these procedures. Nissen fundoplication was better reducing the incidence and severity of symptoms of heart burn and regurgitation while the Toupet fundoplication showed better dysphagia improvements.

3. Patient Satisfaction: High levels of patient satisfaction were reported for both types of fundoplication surgeries. The majority of patients experienced excellent or good outcomes, indicating successful management of symptoms and overall improvement in quality of life.
4. 24-Hour pH Monitoring Improvements: Both surgical methods significantly improved 24-hour esophageal pH monitoring parameters, with a notable reduction in the total percentage of time with pH less than 4, the number of reflux episodes per 24 hour, and the duration of prolonged reflux episodes. Nissen fundoplication showed slightly better results in some pH monitoring measures, but both procedures were effective.
5. The current study results support the use of laparoscopic hernia repair and fundoplication as standard treatment options for patients with persistent GERD symptoms despite medical therapy. Surgeons can consider either Nissen or Toupet fundoplication based on individual patient characteristics most bothering symptoms and surgical expertise.
6. Further research comparing these surgical techniques with other surgical modalities (e.g., magnetic sphincter augmentation or radiofrequency ablation) and non-surgical management strategies could provide a better understanding of the best treatment practices for GERD and hiatal hernia.

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