fortune Journals

Research Article

JOURNAL OF SURGERY AND RESEARCH

ISSN: 2640-1002

Laparoscopic Fundoplication for Hiatal Hernia Gold Standard for The Management of Intractable Reflux Disease

Vinod Kumar Singhal[1*], Faris Al Aswad[2], Md Merajuddin[3], Raafat Samuel Fares[3], Adel Md Suleman[3], Nufra Senopher[4], Vidher VV Singhal[5]

Abstract

Background: Gastroesophageal reflux disease (GERD) is a chronic condition characterized by the backflow of stomach contents into the esophagus, leading to symptoms like heartburn and regurgitation. Hiatal hernia, where stomach organs protrude through the diaphragm, increases GERD risk by disrupting esophageal acid clearance. The surgical management of GERD has advanced, with laparoscopic fundoplication now the preferred approach for intractable cases due to its minimally invasive nature, durability, and effectiveness in symptom relief. Studies confirm laparoscopic fundoplication as the gold standard for long-term GERD control and prevention of symptom recurrence.

Aim of the study: The study aims to evaluate the effectiveness and safety of laparoscopic fundoplication in treating intractable reflux disease caused by hiatal hernia.

Methods: This retrospective study analyzed 1,200 patients with intractable GERD secondary to hiatal hernia who underwent laparoscopic fundoplication over 15 years across multiple centers, including Prime Hospital, Dubai. Patients included were adults with persistent heartburn on proton pump inhibitors. Key data collected encompassed demographics, preoperative symptoms, operative details, and postoperative outcomes, with follow-ups at 1, 6, and 12 months. The surgical procedure entailed reducing the hiatal hernia, repairing the hiatus, and creating a new valve with the gastric fundus.

Result: The study population had a mean age of 47.2 years, showing a balanced gender distribution (52% male, 48% female) and an average BMI of 26.5 kg/m². Most participants (66.25%) had been on proton pump inhibitors for over a year. Heartburn (90.08%) was the most prevalent symptom, followed by regurgitation (85.17%). Postoperatively, laparoscopic fundoplication significantly reduced symptoms, with heartburn decreasing to 10% and regurgitation to 8%. Complications were minimal, with 10% experiencing symptom recurrence and 2% requiring reoperation. Patient satisfaction was high, with 85% reporting positive outcomes following the procedure.

Conclusion: Laparoscopic fundoplication is an effective surgical treatment for intractable GERD related to hiatal hernia, significantly reducing symptoms like heartburn and regurgitation. Patient satisfaction was high at 85%, with low complication rates (10% gas bloat syndrome, 15% dysphagia) and minimal recurrence (10%) and reoperation (2%) rates, affirming its gold standard status.

Affiliation:

[1]Consultant General Surgery, Department of General Surgery, Prime Hospital, Dubai, UAE

[2]Consultant General Surgeon, Department of General Surgery, Gladstone Hospital, Perth, Australia

[3]Specialist General Surgeon, Department of General Surgery, Prime Hospital, Dubai, UAE

[4]Specialist ENT Surgeon, Department of General Surgery, Prime Hospital, Dubai, UAE

[5]Undergraduate, Faculty of Medical Innovation and Enterprise, UCL, London, UK

***Corresponding author:**
Vinod Kumar Singhal, Consultant General Surgery, Department of General Surgery, Prime Hospital, Dubai, UAE

Citation: Vinod Kumar Singhal, Faris Al Aswad, Md Merajuddin, Raafat Samuel Fares, Adel Md Suleman, Nufra Senopher, Vidher VV Singhal. Laparoscopic Fundoplication for Hiatal Hernia Gold Standard for The Management of Intractable Reflux Disease. Journal of Surgery and Research. 7 (2024): 518-524.

Received: November 18, 2024
Accepted: November 28, 2024
Published: December 18, 2024

Singhal VK, et al., J Surg Res 2024
DOI:10.26502/jsr.10020405

Keywords: Laparoscopic Fundoplication; Hiatal Hernia; and Intractable Reflux Disease

Introduction

Gastroesophageal reflux disease (GERD) is a chronic gastrointestinal condition defined by the backflow of stomach contents into the esophagus, impacting approximately 20% of the U.S. population [1]. The etiology of GERD involves various factors, which can be intrinsic, structural, or a combination of both, leading to dysfunction of the esophagogastric junction barrier and resulting in esophageal exposure to acidic gastric contents [2]. Clinically, GERD is primarily recognized by symptoms such as heartburn and regurgitation. However, it may also present atypically, with extra-esophageal symptoms including chest pain, dental erosion, chronic cough, laryngitis, or asthma, complicating diagnosis and treatment [3]. The underlying mechanisms contributing to GERD development remain complex and multifactorial [4]. Anatomical factors, such as the presence of a hiatal hernia, have been linked to a heightened risk of developing gastroesophageal reflux disease (GERD) [5]. Hiatal hernia is a medical condition in which the upper portion of the stomach or other internal organs abnormally protrudes through the diaphragm's hiatus [6]. Substantial evidence indicates that patients with hiatal hernia experience more frequent reflux episodes and heightened esophageal acid exposure compared to those without the condition [7]. Endoscopic findings further reveal that individuals with hiatal hernia are more likely to present with severe esophagitis [8]. Additionally, research demonstrates that larger hiatal hernias correlate with greater esophageal acid exposure and prolonged acid clearance times, amplifying GERD risk [8]. To better understand the mechanisms by which hiatal hernia contributes to GERD, numerous studies have been conducted. During periods of increased abdominal pressure, such as with straining or inhalation, the crural diaphragm contracts, which raises lower esophageal sphincter (LES) pressure to offset the heightened pressure gradient between the stomach and esophagus [9]. At rest, the crural diaphragm also influences LES pressure, as evidenced by studies showing two distinct high-pressure zones in patients with hiatal hernia one at the LES level and another at the crural diaphragm level [10]. This lack of overlap between the LES and the crural diaphragm in patients with hiatal hernia compromises the anti-reflux barrier, thus increasing the likelihood of reflux episodes. The crural diaphragm's role is further underscored in studies indicating that dysfunction in this region is strongly associated with GERD [11]. The global prevalence of GERD ranges from 15% to 25%, with regional variations: Saudi Arabia reports rates as high as 45.4%, while Western Asia reports 10-20%, the Middle East shows 8.7-33.1%, and Eastern Asia less than 10% [12,13]. Hiatal hernia is similarly prevalent, with an estimated 14.5-22% in Western populations, and is more common among non-Hispanic Whites (12.1%) compared to Asian-Americans (2.9%) [14]. The surgical management of GERD has evolved significantly over the years. Early interventions, like Allison's technique, aimed at reducing the hiatal hernia by approximating the diaphragm but only offered temporary relief [15]. Subsequent advancements, such as Hill's posterior gastropexy and Belsey Mark IV, introduced partial fundoplication via thoracotomy, enhancing the effectiveness of surgical treatment for GERD [16]. However, the advent of laparoscopic technology marked a turning point in Intractable gastroesophageal reflux disease (GERD) surgery. Laparoscopic fundoplication (LF), often combined with hiatal hernia repair (HHR), has become the preferred approach due to its minimally invasive nature, effectiveness in symptom relief, and durability of outcomes [17]. Laparoscopic fundoplication reinforces the LES, effectively restoring the anti-reflux barrier, and has become the surgical choice for patients unresponsive to medical therapy. Numerous trials and meta-analyses have demonstrated the procedure's efficacy in GERD management, with technical modifications enhancing outcomes in specific cases [18,19]. Nevertheless, laparoscopic fundoplication has maintained its standing as the gold standard, particularly given its favorable long-term outcomes in symptom control which are untreatable and recurrence prevention [20]. Given the growing body of evidence supporting its outcomes, laparoscopic fundoplication remains the preferred surgical intervention for managing hiatal hernia with refractory GERD. This article aims to examine the clinical outcomes of laparoscopic fundoplication in treating hiatal hernia and evaluate its efficacy as a definitive solution for GER.

Methodology and Materials

This study was designed as a retrospective observational analysis of patients who underwent laparoscopic fundoplication to manage intractable reflux disease (GERD) secondary to hiatal hernia. Over a period of 15 years, 1200 cases were enrolled and analyzed from multiple centers, including Department of General Surgery in Prime Hospital, Dubai, UAE. We reviewed medical records and selected patients who reported heartburn as their primary symptom while on proton pump inhibitor (PPI) therapy. Ethical approval was obtained from the institution's ethics committee.

- **Inclusion criteria:**

Adult patients (aged 18 and above) diagnosed with intractable reflux disease (GERD) and hiatal hernia underwent laparoscopic fundoplication.

- **Exclusion criteria:**

Patients with previous gastric surgery, severe comorbidities contraindicating surgery, or incomplete medical records.

Reflux esophagitis (GERD) was observed through

Singhal VK, et al., J Surg Res 2024
DOI:10.26502/jsr.10020405

endoscopic examinations and classified according to Los Angeles grades [16]. Hiatal hernia was diagnosed using endoscopy before surgery and confirmed through laparoscopic images during the operation. For symptomatic evaluation, patients reported the frequency and severity of GERD symptoms. Typical GERD symptoms were defined as heartburn and regurgitation, while atypical or extra-esophageal manifestations included cough, chest pain, and aspiration. Patients' satisfaction was categorized as high, medium, and low.

Data collection

Data were collected from the hospital's electronic medical records and included patient demographics, preoperative symptoms, operative details, postoperative outcomes, and complications. The specific variables collected were:

Demographics: Age, gender, body mass index (BMI), and duration of symptoms.

Preoperative Symptoms: Frequency and severity of heartburn, regurgitation, dysphagia, chest pain, and chronic cough.

Operative Details: Operative time, hospital stay duration, conversion to open surgery, and intraoperative complications.

Postoperative Outcomes: Frequency and severity of symptoms at follow-up visits (1 month, 6 months, and 12 months post-surgery).

Complications: Any immediate or long-term complications following surgery.

Surgical procedure

All patients underwent laparoscopic fundoplication, which was performed by experienced surgeons using a standardized technique. The procedure involved reducing the hiatal hernia, repairing the diaphragmatic hiatus, and wrapping the gastric fundus around the lower esophagus to create a new valve mechanism.

Follow-up

Postoperative follow-up was conducted at 1 month, 6 months, and 12 months after surgery. Patient symptoms were assessed using standardized questionnaires, and clinical examinations were performed. Long-term outcomes were evaluated, including symptom recurrence, reoperation rates, and patient satisfaction.

Data analysis

Data were analyzed using statistical software (SPSS, V-26.0). Descriptive statistics were used to summarize the patient demographics, preoperative symptoms, operative details, postoperative outcomes, and complications. Continuous variables were presented as means and standard deviations, while categorical variables were presented as frequencies and percentages. The effectiveness of the surgery was assessed by comparing the preoperative and postoperative symptom frequencies using paired t-tests or chi-square tests as appropriate. A p-value of <0.05 was considered statistically significant.

Result

The study included 1,200 participants with a mean age of 47.2 years (range 18-75 years). The gender distribution was fairly balanced, with 52% male and 48% female. The average body mass index (BMI) was 26.5 kg/m², ranging from 20 to 35 kg/m² (Table 1). Table 2 shows that the majority of participants (66.25%) had been on proton pump inhibitor (PPI) treatment for over a year, while 20.75% had been on treatment for less than six months, and 13% had received treatment for six months to a year. Regarding the history of GERD, 44.92% of patients reported experiencing GERD for 1-5 years, 41.25% had symptoms for over 5 years, and 13.83% had GERD for a year or less. Heartburn was the most common symptom (90.08%), followed by regurgitation (85.17%), dysphagia (59.83%), chest pain (40.08%), and chronic cough (25.17%) (Table 2). In terms of the degree of esophagitis, 39.33% had none or minimal esophagitis, 45.92% were classified as Grade A, 9.75% as Grade B, and 3.25% as Grade C. Additionally, 6.58% of patients were diagnosed with Barrett's esophagus (Figure 1). Overall, 118 minutes was the average operative time, and 2.3 days was the mean hospital stay. Conversion to open surgery was necessary in 3% of cases, while intraoperative complications occurred in 2% of patients (Table 3). The study revealed significant improvements in symptoms following laparoscopic fundoplication. Pre-operatively, 90% of patients experienced heartburn, which decreased to 10% post-operatively ($P<0.05$). Regurgitation dropped from 85.17% to 8%, dysphagia from 59.83% to 15%, chest pain from 40.08% to 5%, and chronic cough from 25.17% to 5% (Table 4). Following laparoscopic fundoplication, symptom recurrence was observed in 10% of patients, and the reoperation rate was 2%. Patient satisfaction was generally high, with 85% reporting a high level of satisfaction, 10% expressing medium satisfaction, and 5% reporting low satisfaction (Table 5). Complications included dysphagia (15%), gas bloat syndrome (10%), surgical site infection (3%), and slipped Nissen fundoplication (2%) (Table 6).

Table 1: Baseline characteristics of the study population (N=1200).

Variables	Mean±SD	Range
Age (years)	47.2±10.6	18-75
Gender (Male/Female) (%)	52.0/48.0	
BMI (kg/m²)	26.5±5.2	20-35

Citation: Vinod Kumar Singhal, Faris Al Aswad, Md Merajuddin, Raafat Samuel Fares, Adel Md Suleman, Nufra Senopher, Vidher VV Singhal. Laparoscopic Fundoplication for Hiatal Hernia Gold Standard for The Management of Intractable Reflux Disease. Journal of Surgery and Research. 7 (2024): 518-524.

Singhal VK, et al., J Surg Res 2024
DOI:10.26502/jsr.10020405

Table 2: Clinical history of the study population (N=1200).

Variables	Frequency (n)	Percentage (%)
PPI treatment duration		
<6 months	249	20.75
6 months to 1 year	156	13
>1 year	795	66.25
History of GERD		
≤1 year	166	13.83
1-5 years	539	44.92
>5 years	495	41.25
Symptoms		
Heartburn	1081	90.08
Regurgitation	1022	85.17
Dysphagia	718	59.83
Chest Pain	481	40.08
Chronic Cough	302	25.17

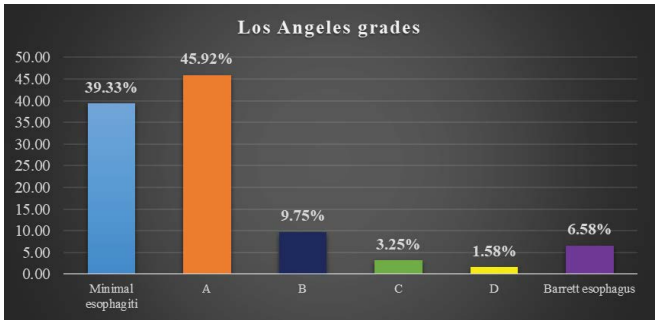

Figure 1: Distribution of Los Angeles grade of esophagitis (N=1200).

Table 3: Operative features among participants.

Variable	Frequency (n)	Percentage (%)
	Mean±SD	
Mean Operative Time (minutes)	118±32	
Mean Hospital Stay (days)	2.3±1.3	
Conversion to Open Surgery	36	3
Intraoperative Complications	24	2

Discussion

This study provides a comprehensive evaluation of laparoscopic fundoplication as a surgical treatment for intractable gastroesophageal reflux disease (GERD) associated with hiatal hernia (HH). The findings demonstrate that the procedure is highly effective in symptom control and is associated with favorable outcomes in most patients. The mean age of the participants was 47.2 years which is consistent with the study of Dowgiałło-Gornowicz et al [22]. It indicates that the procedure is commonly performed in middle-aged adults, though a wide age range is represented. This aligns with the understanding that the prevalence of hiatal hernia and gastroesophageal reflux disease (GERD) tends to increase with age, as older adults are more susceptible to these conditions [23]. The gender distribution was nearly equal in our study with slightly higher occurrence in males which supports the gender-specific prevalence [23]. 26.5 kg/m² was the average BMI ranging from 20 to 35 kg/m². Our results are comparable with the findings of Salvador et al [24]. The majority of participants (66.25%) had been on proton pump inhibitor (PPI) therapy for more than one year, indicating that long-term medical management was the primary approach for most patients. A smaller proportion of patients (20.75%) had been on PPI treatment for less than six months, and 13% had undergone therapy for six months to one year. The history of GERD symptoms reveals that nearly half of the participants (44.92%) had experienced GERD for 1 to 5 years, while 41.25% had suffered from the condition for over 5 years. This finding is significant, as it reflects the chronic nature of GERD in many patients and underscores the long-standing burden of the disease before opting for surgery. Additionally, 13.83% of patients reported having GERD for a year or less, suggesting that a subset of individuals may have had severe or refractory symptoms early in their disease course, leading to a quicker decision for surgical intervention. The degree of esophagitis in the study population shows that 39.33% had none or minimal esophagitis, with most cases being mild (Los Angeles grades A and B). Only a small percentage (3.25%) had more severe esophagitis (grade C), and 6.58% had Barrett's esophagus, indicating some risk of complications from long-term GERD. This highlights the

Table 4: Differences between pre-operative and post-operative symptoms (N=1200).

Symptoms	Pre-operative		Post-operative		P-value
	n	%	n	%	
Heartburn	1081	90.08	120	10	<0.05
Regurgitation	1022	85.17	96	8	
Dysphagia	718	59.83	180	15	
Chest Pain	481	40.08	60	5	
Chronic Cough	302	25.17	60	5	

Citation: Vinod Kumar Singhal, Faris Al Aswad, Md Merajuddin, Raafat Samuel Fares, Adel Md Suleman, Nufra Senopher, Vidher VV Singhal. Laparoscopic Fundoplication for Hiatal Hernia Gold Standard for The Management of Intractable Reflux Disease. Journal of Surgery and Research. 7 (2024): 518-524.

Singhal VK, et al., J Surg Res 2024
DOI:10.26502/jsr.10020405

Table 5: Outcome of laparoscopic fundoplication.

Variable	Frequency (n)	Percentage (%)
Symptom Recurrence	120	10
Reoperation Rate	24	2
Patient Satisfaction		
High	1020	85
Medium	120	10
Low	60	5

Table 6: Complications among the study population (N=1200)

Complication	Frequency (n)	Percentage (%)
Dysphagia	180	15
Gas Bloat Syndrome	120	10
Surgical Site Infection	36	3
Slipped Nissen Fundoplication	24	2

varying severity of esophageal damage in GERD patients, despite similar symptom severity. Our results are consistent with the findings of other researchers [24,25]. Operative data revealed that the procedure is both efficient and safe. In this study, with an average operative time of 118 minutes similar to Neri et al [26], and a mean hospital stay of 2.3 days, laparoscopic fundoplication offers a minimally invasive alternative to open surgery, which tends to have longer recovery times and higher complication rates. According to our observation, only 3% of patients required conversion to open surgery, while intraoperative complications occurred in 2% of cases, both of which are relatively low rates, suggesting a high degree of procedural safety. Neri et al found lesions of diaphragmatic arterial vessels (intraoperative hemostasis) in 2 patients among 12 patients [26]. The pre-operative symptoms, particularly typical symptoms like heartburn and regurgitation, were significantly alleviated following surgery in this study. Heartburn, affecting 90% of patients pre-operatively, dropped to 10%, and regurgitation decreased from 85% to just 8%. Similarly, other GERD-related symptoms like dysphagia, chest pain, and chronic cough showed post-operative improvements. These results indicate the effectiveness of laparoscopic fundoplication in providing symptom relief. Other studies also have shown that typical symptoms are more common than atypical or mixed symptoms and have observed improvement in symptom relief following laparoscopic fundoplication [25,27]. Long-term outcomes were similarly positive. Symptom recurrence was reported in only 10% of patients, and the reoperation rate was low at 2%. Maret-Ouda et al observed a recurrence rate of 17% [28]. Importantly, 85% of patients expressed high satisfaction with the surgery, with only 5% reporting low satisfaction. These high satisfaction rates reflect the durability of symptom relief and the overall success of the procedure in managing reflux disease and HH. This outcome is comparable with the findings of Schwameis et al [29]. However, the procedure was not without complications. Post-operative dysphagia occurred in 15% of patients, and 10% developed gas bloat syndrome, a known side effect of fundoplication that results from the inability to burp or vomit effectively. Surgical site infection was relatively rare (3%), and only 2% of patients experienced a slipped Nissen fundoplication, a complication where the stomach wrap around the esophagus loosens or shifts. Richter et al reported gas-bloat syndrome, dysphagia, diarrhea and flatulence, recurrent heartburn, and recurrent atypical symptoms as late postoperative complications [30].

Limitations of the study: This study has several limitations. The multi-center approach, while broadening the patient base, may introduce variability in surgical techniques and post-operative care. Follow-up data, limited to 12 months, may not capture long-term outcomes, such as symptom recurrence or late complications. Additionally, patient-reported satisfaction is subjective and could vary based on individual expectations. Lastly, while symptom improvement was measured, quality-of-life metrics were not assessed, which may limit insights into the broader impact of laparoscopic fundoplication on daily life.

Conclusion

This study concludes that laparoscopic fundoplication is an effective and reliable surgical treatment for patients with intractable gastroesophageal reflux disease (GERD) related to hiatal hernia. The procedure significantly reduced key GERD symptoms, including heartburn and regurgitation, and showed high patient satisfaction, with 85% reporting positive outcomes. Complications were relatively low, with only 10% experiencing gas bloat syndrome and 15% post-operative dysphagia. Additionally, recurrence and reoperation rates remained minimal at 10% and 2%, respectively. Overall, laparoscopic fundoplication demonstrated durable outcomes, affirming its role as the gold standard in managing refractory GERD and hiatal hernia.

References

1. Fass R, Frazier R. The role of dexlansoprazole modified-release in the management of gastroesophageal reflux disease. Therapeutic advances in gastroenterology 10 (2017): 243-251.
2. Vaezi MF. Extraesophageal manifestations of gastroesophageal reflux disease. Clinical cornerstone 5 (2003): 32-38.
3. Vakil N, Van Zanten SV, Kahrilas P, et al. The Montreal definition and classification of gastroesophageal reflux disease: a global evidence-based consensus. Official journal of the American College of Gastroenterology| ACG 101 (2006): 1900-1920.

Singhal VK, et al., J Surg Res 2024
DOI:10.26502/jsr.10020405

4. Antunes C, Aleem A, Curtis SA. Gastroesophageal reflux disease. InStatPearls 2023 Jul 3. StatPearls Publishing (2023).

5. Argyrou A, Legaki E, Koutserimpas C, et al. Risk factors for gastroesophageal reflux disease and analysis of genetic contributors. World journal of clinical cases 6 (2018): 176.

6. Smith RE, Sharma S, Shahjehan RD. Hiatal hernia. InStatPearls. StatPearls Publishing (2024).

7. Van Herwaarden MA, Samsom M, Smout AJ. Excess gastroesophageal reflux in patients with hiatus hernia is caused by mechanisms other than transient LES relaxations. Gastroenterology 119 (2000): 1439-1446.

8. Jones MP, Sloan SS, Jovanovic B, et al. Impaired egress rather than increased access: an important independent predictor of erosive oesophagitis. Neurogastroenterology & Motility 14 (2002): 625-631.

9. Van Herwaarden MA, Samsom M, Smout AJ. The role of hiatus hernia in gastro-oesophageal reflux disease. European journal of gastroenterology & hepatology 16 (2004): 831-835.

10. Andrews WG, Louie BE. The relationship of hiatal hernia and gastroesophageal reflux symptoms-Two-sphincter hypothesis: A review. Annals of Laparoscopic and Endoscopic Surgery 20 (2021): 6.

11. Pandolfino JE, Kim H, Ghosh SK, et al. High-resolution manometry of the EGJ: an analysis of crural diaphragm function in GERD. Official journal of the American College of Gastroenterology| ACG 102 (2007): 1056-1063.

12. Alsuwat OB, Alzahrani AA, Alzhrani MA, et al. Prevalence of gastroesophageal reflux disease in Saudi Arabia. Journal of clinical medicine research 10 (2018): 221.

13. Alshammari SA, Alabdulkareem AM, Aloqeely KM, et al. The determinants of the quality of life of gastroesophageal reflux disease patients attending King Saud University Medical City. Cureus 12 (2020).

14. Kim J, Hiura GT, Oelsner EC, et al. Hiatal hernia prevalence and natural history on non-contrast CT in the Multi-Ethnic Study of Atherosclerosis (MESA). BMJ open gastroenterology 8 (2021): e000565.

15. Allison PR. Hiatus hernia: (a 20-year retrospective survey). Annals of surgery 178 (1973): 273-276.

16. Hill LD, Gelfand M, Bauermeister D. Simplified management of reflux esophagitis with stricture. Annals of surgery 172 (1970): 638.

17. Targarona EM, Novell J, Vela S, et al. Mid term analysis of safety and quality of life after the laparoscopic repair of paraesophageal hiatal hernia. Surgical Endoscopy And Other Interventional Techniques 18 (2004): 1045-1050.

18. Watson DI, Jamieson GG, Pike GK, et al. Prospective randomized double-blind trial between laparoscopic Nissen fundoplication and anterior partial fundoplication. British journal of surgery 86 (1999): 123-130.

19. Gonçalves-Costa D, Barbosa JP, Quesado R, et al. Robotic surgery versus Laparoscopic surgery for anti-reflux and hiatal hernia surgery: a short-term outcomes and cost systematic literature review and meta-analysis. Langenbeck's Archives of Surgery 409 (2024): 1-2.

20. Frazzoni M, Piccoli M, Conigliaro R, et al. Laparoscopic fundoplication for gastroesophageal reflux disease. World journal of gastroenterology: WJG 20 (2014): 14272.

21. Azer SA, Hashmi MF, Reddivari AK. Gastroesophageal Reflux Disease (GERD). StatPearls (2023).

22. Dowgiałło-GN, Kacperczyk J, Masiewicz A, et al. Impact of Age on Long-Term Outcomes of Laparoscopic Nissen Fundoplication- A Single Center Study. Medicina 60 (2024): 688.

23. Alsahafi MA, Alajhar NA, Almahyawi AO, et al. The prevalence and risk factors for hiatal hernia among patients undergoing endoscopy: A retrospective analysis. Saudi Medical Journal 44 (2023): 509.

24. Salvador R, Vittori A, Capovilla G, et al. Antireflux Surgery's Lifespan: 20 Years After Laparoscopic Fundoplication. Journal of Gastrointestinal Surgery 27 (2023): 2325-2335.

25. Lee TG, Lee IS, Kim BS, et al. Surgical outcomes and over one-year follow-up results of laparoscopic Nissen fundoplication for gastroesophageal reflux disease: Single-center experiences. Asian Journal of Surgery 42 (2019): 557-562

26. Neri V, Ambrosi A, Di Lauro G, et al. Indications for the laparoscopic treatment of gastroesophageal reflux disease. JSLS: Journal of the Society of Laparoendoscopic Surgeons 9 (2005): 68.

27. Park JM, Kim BJ, Kim JG, et al. Factors predicting outcomes of laparoscopic Nissen fundoplication for gastroesophageal reflux disease: experience at a single institution in Korea. Annals of Surgical Treatment and Research 92 (2017): 184-190.

28. Maret-Ouda J, Wahlin K, El-Serag HB, et al. Association between laparoscopic antireflux surgery and recurrence of gastroesophageal reflux. Jama 318 (2017): 939-946.

29. Schwameis K, Oh D, Green KM, et al. Clinical outcome

Singhal VK, et al., J Surg Res 2024
DOI:10.26502/jsr.10020405

after laparoscopic Nissen fundoplication in patients with GERD and PPI refractory heartburn. Diseases of the Esophagus 33 (2020): doz099.

30. Richter JE. Gastroesophageal reflux disease treatment: side effects and complications of fundoplication. Clinical Gastroenterology and Hepatology 11 (2013): 465-471.

Citation: Vinod Kumar Singhal, Faris Al Aswad, Md Merajuddin, Raafat Samuel Fares, Adel Md Suleman, Nufra Senopher, Vidher VV Singhal. Laparoscopic Fundoplication for Hiatal Hernia Gold Standard for The Management of Intractable Reflux Disease. Journal of Surgery and Research. 7 (2024): 518-524.