# Comparison of Partial Endoscopic vs Surgical Fundoplication after Hiatal Hernia Repair

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**BACKGROUND:** The concomitant hiatal hernia repair with endoscopic fundoplication (c-TIF) is a novel antireflux procedure that addresses the hiatus and the gastroesophageal flap valve for surgical candidates with GERD. We aim to compare the outcomes of a TIF vs surgical partial fundoplication (anterior and posterior) with regard to quality-of-life (QoL) scores at 12 months after surgery.

**STUDY DESIGN:** Following IRB approval, a prospectively maintained antireflux database was retrospectively reviewed to identify patients who underwent a c-TIF procedure or a surgical hiatal hernia repair with partial fundoplication. The primary endpoint was QoL scores at 2, 6, and 12 months from surgery, with attention to bloating and dysphagia scores. Secondary endpoints were proton pump inhibitor (PPI) use, 30-day outcomes, operating room time and costs, reoperation within 1 year. The 3 groups were compared using ANOVA for continuous variables and Pearson's chi-square test for categorical variables. A p value of <0.05 was considered indicative of statistical significance.

**RESULTS:** Demographics between groups were similar except for age, PPI use, and presenting symptoms. There was no difference between the 3 groups with regard to postoperative QoL scores, PPI use, dysphagia, or bloating. All 3 types of fundoplication are associated with significant improvement of all symptom types, and 65% to 80% of patients are no longer using a PPI at 12 months.

**CONCLUSIONS:** There are no differences in outcomes between the c-TIF and a surgical partial fundoplication. QoL scores significantly decrease with all partial fundoplications, and there are no differences in dysphagia or bloating between the 3 types of fundoplication. Long-term data are necessary to see whether either technique provides superior control of symptoms while minimizing dysphagia and bloating (J Am Coll Surg 2025;240:508–514. © 2025 by the American College of Surgeons. Published by Wolters Kluwer Health, Inc. All rights reserved.)

GERD remains a common diagnosis in the US, and its prevalence has steadily increased over the years.[1] Medical therapy remains the mainstay for the management of GERD symptoms, but a subset of patients fail medical therapy for a number of reasons. Patients with progressive symptoms despite medical therapy, intolerance to medical therapy, evidence of erosive esophagitis or intestinal metaplasia on endoscopy, the presence of a hiatal/paraesophageal hernia, and other concerning sequelae of GERD should be referred for consideration of antireflux surgery (ARS).[2]

With advancement in surgical and endoscopic techniques, ARS no longer carries high rates of morbidity and mortality compared with the procedures of the past

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**Abbreviations and Acronyms**

| | | |
|---|---|---|
| ARS | = | antireflux surgery |
| c-TIF | = | concomitant hiatal hernia repair with transoral incisionless fundoplication |
| LNF | = | laparoscopic Nissen fundoplication |
| LPF | = | laparoscopic partial fundoplication |
| PPI | = | proton pump inhibitor |
| QoL | = | quality of life |
| OR | = | operating room |

and has been shown to be superior to medical treatment in well-selected patients.[3] Laparoscopic and robotic approaches are safe and well tolerated and are necessary to restore normal anatomy at the hiatus, especially in patients with a hiatal hernia. A fundoplication augments the lower esophageal sphincter complex by accentuating the angle of His and reinforcing the gastroesophageal flap valve. Traditionally, a laparoscopic Nissen (360-degree angle) fundoplication (LNF) has been the gold standard for ARS and is associated with a 70% to 80% success rate with regard to symptom improvement and ability to discontinue proton pump inhibitor (PPI) therapy.[4] However, the incidence of bothersome gas bloat and dysphagia with the Nissen fundoplication is reported to be between 10% and 20% in the long term, which has kindled interest in developing a better understanding of fundoplication anatomy and function. Laparoscopic partial fundoplications (LPF) have long been the alternative to a Nissen fundoplication as they are associated with a lower risk of dysphagia/gas bloat; however, they do have slightly higher rates of long-term recurrent reflux.[4-6]

Over the last 17 years, an endoscopic fundoplication technique has been developed, modified, and shown to be safe and well tolerated,[7] superior to medication alone, and associated with less dysphagia and gas bloat compared with an LNF.[8] The transoral incisionless fundoplication (TIF) using the "EsophyX" device (EndoGastric Solutions Inc, Redmond, WA) was developed as a less invasive and reproducible option for fundoplication creation and was approved by the FDA for patients with a hiatal hernia 2 cm or less who have GERD. Evidence suggests that even a small hiatal hernia made the TIF less effective, so the concomitant hiatal hernia repair with TIF (c-TIF) was developed to surgically address the hiatal hernia and endoscopically create the fundoplication.[9] This procedure has been shown to be safe, well tolerated, and very effective for reducing quality-of-life (QoL) scores as well as distal esophageal acid exposure 6 months after surgery.[10] Although the TIF was originally indicated for hernias <5 cm in size, some studies have shown acceptable results performing the c-TIF in patients with larger paraesophageal hernias.[11]

As the TIF is relatively new, long-term data are scarce. Some series demonstrate ongoing success 10 years after the procedure[12] and these data have helped to increase enthusiasm for the TIF among gastroenterologists, surgeons, and patients alike. There are even less data comparing the c-TIF with a partial surgical fundoplication of any kind. In essence, a TIF is a partial fundoplication, so a comparison of outcomes between a c-TIF and an LPF would be most logical. Surgical literature comparing LNF and LPF consistently demonstrates lower rates of dysphagia and gas bloat in the LPF groups, with slightly higher rates of recurrent reflux in the LPF group.[4-6] This has led many surgeons who specialize in ARS to perform more partial fundoplications in an effort to improve patient outcomes. With the TIF as a new tool to use in ARS, a comparison of the c-TIF with an LPF would have much clinical relevance and investigating this has been deemed a priority by surgical societies.[13]

## HYPOTHESIS

Our hypothesis is that the c-TIF procedure and a laparoscopic hiatal hernia repair with partial fundoplication will demonstrate no significant differences with regard to postoperative QoL scores, nor any difference between postoperative rates of dysphagia and bloating.

## METHODS

An IRB-approved prospectively maintained ARS database was retrospectively reviewed to identify patients undergoing primary ARS with a partial fundoplication of any kind between January 1, 2022, and January 1, 2024, at a single institution. This includes patients who had a laparoscopic hiatal hernia repair with either a TIF, a partial anterior, or a partial posterior fundoplication. Five surgeons performed the surgeries, and 3 gastroenterologists performed the TIFs. Study data were collected and managed using Research Electronic Data Capture, a secure web platform for building and managing online databases.

Patients with previous foregut surgeries were excluded from this review. Demographics were compiled and patients had pre- and postoperative QoL scores tracked. We collected GERD Health-Related Quality of Life, Regurgitation, and Laryngopharyngeal Reflux Reflux Symptom Index Scores at 2 months, 6 months, and annually for all patients who participated in follow-up. To evaluate dysphagia and bloating, 3 questions from the GERD-HRQL were individually analyzed: difficulty swallowing, painful swallowing, and bloating. As these scores are based on a scale of 0 to 5, we postulated that clinically significant symptoms correspond to scores 3 to 5 and

clinically insignificant symptoms correspond to scores 0 to 2. To determine a change in these symptoms, we compared preoperative and postoperative scores based on this distinction. Additionally, operating room (OR) time, hospital length of stay (LOS), and total OR supply costs were compared between the c-TIF and LPF groups. Thirty-day outcomes were compared, as were intraoperative complications. Reoperations were tracked for the first year after the index procedure.

The 3 surgical groups were compared using ANOVA for continuous variables and Pearson's chi-square test for categorical variables. If the overall p value was statistically significant, multiple pairwise comparisons were conducted using Tukey's Honestly Significant Difference test for continuous data and the Bonferroni method for categorical data. Differences in QoL scores from baseline (preoperative) to follow-up, within the surgical group, were assessed using Student's 1-sample *t*-test. P values of <0.05 were considered indicative of statistical significance. All analyses were conducted using the SAS Enterprise Guide, version 8.3 (SAS Institute, Cary, NC).

## RESULTS

A total of 255 patients underwent a hiatal hernia repair with partial fundoplication in the reviewed time period: 111 partial anterior fundoplication, 98 partial posterior fundoplication, and 46 TIF. The groups were different with respect to age, preoperative PPI use, and presenting symptoms (Table 1).

There were no significant differences in postoperative QoL scores or dysphagia and bloating incidences between partial anterior, partial posterior, and c-TIF at 1 year after the index procedure (Table 2). All patients noted marked improvement in QoL scores postoperatively, and all patients were able to discontinue PPI therapy at similar rates. Reasons for continued PPI use were persistent or recurrent reflux symptoms, presence of intestinal metaplasia in the distal esophagus, and continuation by another provider.

Specific symptom scores (GERD, regurgitation, and laryngopharyngeal reflux) demonstrated significant decreases compared with baseline scores, but there was no difference noted between types of fundoplication. There was a higher rate of 30-day GI complications after surgical fundoplication (13%) than after c-TIF (2.4%; Table 3). Operative times were different between the 3 procedures, but the difference was minimal and felt to be clinically insignificant. OR cost was significantly higher for the c-TIF population, and hospital LOS was higher for the partial anterior fundoplication group (Table 4).

Intraoperative complications in the c-TIF group are notable for 1 proximal esophageal perforation, which was managed nonoperatively. The partial anterior fundoplication group had 1 esophageal injury and 1 conversion to open due to hernia size. The partial posterior fundoplication group had 1 diaphragmatic injury, which necessitated pledgets and absorbable mesh placement at the hiatus. Within 30 days of surgery, 1 patient in the partial anterior group had an early recurrence, which required surgical reduction and gastropexy, and 1 patient in the partial posterior group had a cholecystectomy for cholecystitis.

Four patients in the partial anterior group had reoperations in the first year for symptomatic hernia recurrences: 2 with GERD symptoms and 2 with dysphagia. One patient in the partial posterior group had a reoperation for dysphagia. Three patients in the TIF group underwent repeat TIF within 1 year for persistent/recurrent GERD symptoms.

## DISCUSSION

With improvements in surgical and endoscopic techniques and devices, we continue to expand our options for treating patients with refractory GERD. Although surgical complete (Nissen) fundoplications are still the most common surgical intervention performed, partial fundoplications are becoming a more attractive option. This is based on long-term data reporting equivalent control of reflux symptoms, a lower side-effect profile,[4-6] and multisociety guidelines conditionally recommending that "patients with GERD may benefit from partial fundoplication compared to complete fundoplication."[13]

The c-TIF has generated much enthusiasm as a less invasive way to provide durable symptom control, allow for discontinuation of medications, and reduce the side-effect profile often seen with the Nissen fundoplication.[14,15] This is especially relevant today because recent studies investigating the effects of long-term PPI suggest a correlation with electrolyte abnormalities, GI infections, and the development of gastric polyps and potential malignancy.[16] Other associations with bone disease, renal dysfunction, dementia, and cardiovascular health have been reported as well,[17] which is leading to a change in prescribing practices of PPI medications. With roughly 25% to 30% of the population using PPI medications (prescribed and over the counter)[18] there will be a surge of interest in endoscopic and surgical options to treat reflux disease in the coming years.

Several studies have aimed to compare the c-TIF procedure with an LNF. The results suggest that the c-TIF

**Table 1.** Patient, Clinical, and Operative Characteristics by Fundoplication Group

| Characteristic | Partial anterior (group 1) | Partial posterior (group 2) | TIF (group 3) | p Value |
|---|---|---|---|---|
| No. of patients | 111 | 98 | 46 | — |
| Age, y, mean ± SD | 68.7 ± 11.1 | 60.7 ± 12.0 | 55.0 ± 12.8 | <0.001* |
| Sex, n (%) | | | | |
| Female | 85 (76.6) | 70 (71.4) | 33 (74.7) | 0.662 |
| Male | 26 (23.4) | 28 (28.6) | 13 (28.3) | |
| BMI, kg/m$^2$, mean ± SD | 28.7 ± 4.7 | 28.7 ± 4.0 | 29.3 ± 2.9 | 0.756 |
| Current smoker (<1 y), n (%) | 9 (8.1) | 11 (11.2) | 3 (6.5) | 0.594 |
| Comorbidity, n (%) | | | | |
| Hypertension | 73 (65.8) | 55 (56.1) | 20 (43.5) | 0.032* |
| Diabetes | 14 (12.6) | 9 (9.2) | 3 (6.5) | 0.473 |
| COPD | 12 (10.8) | 5 (5.1) | 0 (0.0) | 0.035* |
| Chronic renal insufficiency | 1 (0.9) | 5 (5.1) | 3 (6.5) | 0.124 |
| Coronary artery disease | 10 (9.0) | 5 (5.1) | 4 (8.7) | 0.528 |
| Autoimmune disease | 7 (6.3) | 5 (5.1) | 2 (4.4) | 0.867 |
| Anxiety, depression, bipolar | 51 (46.0) | 47 (48.0) | 26 (56.5) | 0.567 |
| PPI user preoperatively, n (%) | 79 (71.2) | 89 (90.8) | 43 (93.5) | <0.001* |
| Primary symptom, n (%) | | | | |
| Typical | 93 (83.8) | 91 (92.9) | 42 (91.3) | 0.098 |
| Atypical | 25 (22.5) | 20 (20.4) | 18 (39.1) | 0.041* |
| Dysphagia | 50 (45.1) | 38 (38.8) | 8 (17.4) | 0.005* |
| Large hernia | 9 (8.1) | 6 (6.1) | 0 (0.0) | 0.144 |
| GERD-HRQL Score, mean ± SD | 22.1 ± 14.1 | 24.9 ± 11.7 | 26.3 ± 10.1 | 0.085 |
| Regurgitation Score, mean ± SD | 14.2 ± 10.0 | 16.6 ± 9.3 | 17.8 ± 7.6 | 0.059 |
| LPR-RSI, mean ± SD | 18.4 ± 11.6 | 18.9 ± 10.6 | 18.3 ± 10.5 | 0.934 |
| From GERD-HRQL | | | | |
| Difficulty swallowing, n (%) | | | | |
| 0–2 (minimal) | 30 (34.1) | 29 (40.3) | 20 (45.5) | 0.425 |
| 3–5 (clinically significant) | 58 (65.9) | 43 (59.7) | 24 (54.6) | |
| Painful swallowing, n (%) | | | | |
| 0–2 (minimal) | 44 (50.0) | 43 (59.7) | 28 (63.6) | 0.256 |
| 3–5 (clinically significant) | 44 (50.0) | 29 (40.3) | 16 (36.4) | |
| Bloating, n (%) | | | | |
| 0–2 (minimal) | 21 (23.9) | 19 (26.4) | 11 (25.0) | 0.935 |
| 3–5 (clinically significant) | 67 (76.1) | 53 (73.6) | 33 (75.0) | |

*Statistically significant.
GERD-HRQL, GERD Health-Related Quality of Life; LPR-RSI, Laryngopharyngeal Reflux Reflux Symptom Index; PPI, proton pump inhibitor; TIF, transoral incisionless fundoplication.

is noninferior to the LNF with regard to symptom control and PPI use, as well as having an improved side-effect profile with regard to dysphagia and gas bloat.[15] Theories behind the reduced side effects center on the technique of the TIF. The 60-Fr device maintains patency of the distal esophagus while the fundoplication is created, which may prevent dysphagia. The ability to distend the stomach to better oppose the fundus to the esophagus helps to create a 2- to 3-cm valve that can be wrapped anteriorly and posteriorly for a 200- to 300-degree fundoplication and allows for excellent control of acid reflux. The fundus is not wrapped around the lesser curved side of the GE junction, and this is believed to improve the ability to belch and vomit after surgery. More than 20 prolene fasteners are deployed between the esophagus and stomach, providing many points of fixation between the organs, which would suggest improved long-term durability. Finally, the technique is reproducible and subject to minimal variation once the learning curve has been ascended.[19] With regard to reoperative ARS after a TIF, it has been shown

**Table 2.** Twelve-Month Postoperative Outcomes by the Fundoplication Group

| Characteristic | Partial anterior (group 1) | Partial posterior (group 2) | TIF (group 3) | p Value |
|---|---|---|---|---|
| PPI use at 12 mo, n/N (%) | 20/59 (33.9) | 11/31 (35.5) | 5/24 (20.8) | 0.439 |
| Foregut reoperation within 1 y, n/N (%) | 4/80 (5.0) | 1/34 (2.9) | 3/24 (12.5) | 0.276 |
| GERD Score | | | | <0.001* |
| Patients w/ GERD Score at 12 mo, n | 48 | 30 | 23 | — |
| GERD Score preoperatively, mean (SE) | 21.9 (2.0) | 23.8 (2.5) | 27.1 (2.1) | — |
| GERD Score at 12 mo, mean (SE) | 7.2 (1.1) | 8.1 (2.0) | 9.2 (1.9) | — |
| Difference in GERD Score, mean (SE) | –14.7 (2.1) | –15.6 (2.9) | –17.9 (2.5) | 0.674 |
| REGURG Score | | | | <0.001* |
| Patients w/ REGURG Score at 12 mo, n | 47 | 30 | 22 | — |
| REGURG Score preoperatively, mean (SE) | 15.1 (1.4) | 16.8 (1.9) | 18.7 (1.4) | — |
| REGURG Score at 12 mo, mean (SE) | 3.6 (0.9) | 4.0 (1.4) | 3.6 (0.9) | — |
| Difference in REGURG Score, mean (SE) | –11.5 (1.5) | –12.9 (2.6) | –15.1 (1.6) | 0.448 |
| LPR Score | | | | <0.001* |
| Patient w/ LPR Score at 12 mo, n | 40 | 28 | 22 | — |
| LPR Score preoperatively, mean (SE) | 18.8 (1.8) | 17.8 (2.2) | 21.2 (2.2) | — |
| LPR Score at 12 mo, mean (SE) | 8.6 (1.2) | 8.3 (1.8) | 9.2 (1.4) | — |
| Difference in LPR Score, mean (SE) | –10.2 (1.7) | –9.5 (2.1) | –12.0 (2.1) | 0.693 |
| Improvement from score of 3–5 (clinically significant) to 0–2 (minimal), n/N (%) | | | | |
| Difficulty swallowing | 20/29 (69.0) | 8/14 (57.1) | 7/12 (58.3) | 0.685 |
| Painful swallowing | 18/21 (85.7) | 5/9 (55.6) | 6/8 (75.0) | 0.204 |
| Bloat | 14/34 (41.2) | 6/19 (31.6) | 10/19 (52.6) | 0.419 |
| Worsening in score of 1–2 (minimal) to 3–5 (clinically significant), n/N (%) | | | | |
| Difficulty swallowing | 1/17 (5.9) | 2/14 (14.3) | 1/10 (10.0) | 0.735 |
| Painful swallowing | 1/25 (4.0) | 2/19 (10.5) | 0/14 (0) | 0.378 |
| Bloat | 5/12 (41.7) | 1/8 (12.5) | 0/3 (0) | 0.189 |

*p Value for difference within group.
LPR, laryngopharyngeal reflux; REGURG, regurgitation; TIF, transoral incisionless fundoplication.

**Table 3.** 30-Day Postoperative Outcomes by the Fundoplication Group

| Characteristic | Partial anterior (group 1) | Partial posterior (group 2) | TIF (group 3) | p Value |
|---|---|---|---|---|
| No. of patients | 111 | 98 | 46 | — |
| Gastrointestinal complication, n (%) | 16 (15.8) | 8 (9.5) | 1 (2.4) | 0.055 |
| Nausea/vomiting | 8 | 5 | 0 | |
| Dysphagia | 4 | 2 | 0 | |
| Dehydration | 3 | 3 | 1 | |
| Abdominal pain | 5 | 1 | 0 | |
| ED visit or hospital readmission within 30 d, n (%) | 9 (8.1) | 7 (7.1) | 1 (2.4) | 0.387 |
| Reoperation within 30 d, n (%) | 1 (1.0) | 1 (1.0) | 0 | 0.543 |

There is a statistical difference in partial fundoplication (2 groups combined) vs TIF (13.0% vs 2.4%, p = 0.048).
ED, emergency department; TIF, transoral incisionless fundoplication.

safe and effective and does not require fully dismantling the fundoplication.[20]

What is not clear is how the TIF stacks up against a surgical partial fundoplication and our study is unique in that it compares outcomes of each type of partial fundoplication performed after hiatal hernia repair. Our study shows that each type of fundoplication is very effective in reducing QoL scores without increasing rates of dysphagia and bloating. We looked at 3 different time points in the first year, and none of these demonstrated significant differences between

**Table 4.** Operating Room Cost, Operative Time, and Length of Stay

| Characteristic | Partial anterior (group 1) | Partial posterior (group 2) | TIF (group 3) | p Value |
|---|---|---|---|---|
| No. of patients | 111 | 98 | 46 | — |
| Operative time, min, mean ± SD | 148 ± 58 | 123 ± 39 | 134 ± 25 | <0.001* |
| Total OR supply cost, $, mean ± SD | 1,703 ± 724 | 2,059 ± 965 | 6,903 ± 1,334 | <0.001* |
| Intraoperative complication, n (%) | 2 (1.8) | 1 (1.0) | 1 (2.2) | 0.849 |
| Hospital LOS, n (%) | | | | |
| ≤POD1 | 75 (67.6) | 87 (88.8) | 39 (84.8) | <0.001* |
| >POD1 | 36 (32.4) | 11 (11.2) | 7 (15.2) | |

*Statistically significant.
LOS, length of stay; OR, operating room; POD, postoperative day; TIF, transoral incisionless fundoplication.

the 3 groups. Between 65% and 80% of our patients were not taking PPI medications 1 year after surgery, which is in line with the current literature.[4,5,15]

Intraoperative complications were rare for all groups and able to be managed conservatively. Thirty-day outcomes were notable for more GI complications (nausea or vomiting, dehydration, dysphagia, and abdominal pain) in the surgical fundoplication groups compared with the c-TIF group, and LOS was also slightly higher in the surgical anterior fundoplication group as was long-term bloating. We believe these findings are due to the partial anterior fundoplication group having an average higher age, more comorbidities, and typically larger hernias.

OR times varied slightly between the groups, but most notable is that total OR costs were different, with the c-TIF incurring a roughly $5,000 higher supply cost. Reoperation rates within 1 year are similar across groups and were performed at surgeon or endoscopist discretion based on symptoms. The partial anterior group tended to have symptomatic hernia recurrence, and this is likely due to preoperative hernia size as well as the technical aspects of an anterior fundoplication, which may not anchor the esophagus intra-abdominally as well as the TIF or partial posterior fundoplication. The 3 patients who had a repeat TIF in the first year had an endoscopically loose valve noted on endoscopy before reintervention. This could be attributed to the learning curve of performing the TIF, or perhaps suggests that the fasteners at the most extreme ends of the fundoplication are susceptible to tension and gradually pull through.

Based on the results of our study, it appears that a partial fundoplication of any type is an effective way to manage reflux and that one can perform any of these fundoplications with a low risk of postoperative dysphagia and bloating. OR cost may be a consideration when making this decision, but longer-term follow-up is required to see whether the endoscopic wrap is more durable and worth the increased cost.

There are several limitations to our study. As this is a retrospective review, the patient groups were not controlled and were found to be quite different in certain aspects. This selection bias is a reflection of our practice pattern in which older patients with larger hernias receive a partial anterior fundoplication at higher rates. This is often a quicker fundoplication that does not require division of the short gastric vessels and does not have high rates of dysphagia postoperatively. Some of our surgeons routinely perform partial posterior fundoplications, but others do so only in patients with dysmotility, which is not something we tracked in this study. Technique for performing these fundoplications is variable between the 5 surgeons as well and this may factor in to the results. The c-TIF was initially approved in patients with hernias 5 cm or less and no evidence of esophagitis or intestinal metaplasia, so this naturally selects younger patients with small hernias and perhaps less severe disease. These differences in patient characteristics may also explain some of the higher rates of GI complications after surgery. A prospective randomized trial would help remove these confounding factors.

Our follow-up is also a limitation. Despite 255 patients undergoing procedures during this period, we were only able to study 114 patients at 12 months. Between 6 and 12 months, we lost 66 patients to follow-up, despite sending QoL forms electronically, and this may have reduced our ability to detect a difference between groups. We also did not measure objective pH data in this study. Our results are based on subjective patient questionnaires, which may not be the most reliable way to truly determine the efficacy of a procedure intended to reduce acid exposure in the distal esophagus.[21] Ideally, all patients would receive imaging and functional studies 1 year after surgery and annually after that to offer a more objective comparison between techniques over a considerable amount of time.

Finally, our study only looks at results for up to 1 year. The true shelf life of a fundoplication is a moving target, and there are many factors that may lead to medication resumption and reoperation after ARS. Determining a difference in longevity would truly be beneficial for patients as reoperations tend to be technically difficult, less durable

for the long term, and anxiety provoking for patients. This may also help justify some of the upfront costs of a procedure, such as the c-TIF, if it can be shown to last longer than a surgical partial fundoplication, thereby reducing the need for further interventions and medications.

We believe that all 3 of these fundoplication options are effective, safe, and reproducible. A major question to answer is, if they all work well, why should one be done over another? This will inevitably come down to surgeon or endoscopist preference as well as patient preference, but our study can lend support to justifying any option. We believe there are benefits to each type of fundoplication, and these are based on patient characteristics as well as the technique used for each fundoplication.

## CONCLUSIONS

There is no significant difference in QoL outcomes at 1 year between a c-TIF procedure and a laparoscopic partial fundoplication. Partial fundoplications of any type are effective ways to treat refractory GERD and have a limited side-effect profile.

### Author Contributions

Conceptualization: Hodgens, Kothari
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Methodology: Hodgens, Sunkavalli, Blackhurst, Kothari
Writing – review & editing: Hodgens, Blackhurst, Kothari
Formal analysis: Blackhurst

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