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Australia and New Zealand Horizon Scanning Network

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AN INITIATIVE OF THE NATIONAL, STATE AND
TERRITORY GOVERNMENTS OF AUSTRALIA
AND THE GOVERNMENT OF NEW ZEALAND

Horizon Scanning Technology Prioritising Summary

EsophyX™ System

February 2009



Australian
Safety
and Efficacy
Register
of New
Interventional
Procedures -
Surgical



**Royal Australasian
College of Surgeons**

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PRIORITISING SUMMARY

REGISTER ID S000093

NAME OF TECHNOLOGY ESOPHYX™ SYSTEM

PURPOSE AND TARGET GROUP FOR THE TREATMENT OF SYMPTOMATIC CHRONIC GASTRO-OESOPHAGEAL REFLUX DISEASE IN PATIENTS RESPONSIVE TO PHARMACOLOGICAL THERAPY

STAGE OF DEVELOPMENT (IN AUSTRALIA)

- | | |
|---|---|
| <input checked="" type="checkbox"/> Yet to emerge | <input type="checkbox"/> Established |
| <input type="checkbox"/> Experimental | <input type="checkbox"/> Established <i>but</i> changed indication or modification of technique |
| <input type="checkbox"/> Investigational | <input type="checkbox"/> Should be taken out of use |
| <input type="checkbox"/> Nearly established | |

AUSTRALIAN THERAPEUTIC GOODS ADMINISTRATION APPROVAL

- | | | |
|---|-------------|-----|
| <input type="checkbox"/> Yes | ARTG number | N/A |
| <input checked="" type="checkbox"/> No | | |
| <input type="checkbox"/> Not applicable | | |

INTERNATIONAL UTILISATION

| COUNTRY | LEVEL OF USE | | |
|--------------|------------------------------|-------------|-----------------|
| | Trials Underway or Completed | Limited Use | Widely Diffused |
| Austria | | ✓ | |
| Belgium | | ✓ | |
| Denmark | | ✓ | |
| France | | ✓ | |
| Germany | | ✓ | |
| Greece | | ✓ | |
| Ireland | | ✓ | |
| Italy | | ✓ | |
| Luxemburg | | ✓ | |
| Mexico | | ✓ | |
| Netherlands | | ✓ | |
| South Africa | | ✓ | |
| Spain | | ✓ | |

| | | | |
|----------------|--|---|--|
| Portugal | | ✓ | |
| United Kingdom | | ✓ | |
| United States | | ✓ | |

IMPACT SUMMARY

The EsoPHYX™ Transoral Incisionless Fundoplication system (EndoGastric Solutions, Washington, United States) treats gastro-oesophageal reflux disease (GORD) by reconstructing the gastro-oesophageal valve, accessing it via the oesophagus. The technology is appropriate for GORD patients that are responsive to pharmacological therapy, and is available through gastroenterologists.

BACKGROUND

Gastro-oesophageal reflux disease (GORD) is a mechanical disorder in which a defective lower oesophageal sphincter does not close and stomach contents reflux into the oesophagus (Smith 2008).

The most common symptoms experienced by GORD sufferers include heartburn, regurgitation, dysphagia and chest pain (Kahrilas 2008). Other, less common symptoms include odynophagia, excessive salivation and nausea (Kahrilas 2008).

GORD can result in injury to the oesophagus leading to conditions such as reflux oesophagitis, oesophageal strictures, Barrett's oesophagus and oesophageal adenocarcinoma (Kahrilas 2008).

Treatment for GORD generally follows one of two main pathways, pharmacological or surgical. Pharmacological therapy involves the long term use of anti-reflux medications to control GORD symptoms, while surgical therapy generally involves a procedure to strengthen the gastro-oesophageal valve. Regardless of the pathway selected, treatment of GORD almost always includes lifestyle modifications such as (Kaltenbach et al 2006; Piesman et al 2007):

- Weight loss
- Elevating the head of the bed
- Avoiding eating two hours before bedtime
- Dietary changes

While the use of proton pump inhibitors (PPI) in pharmacological therapy as the first treatment option often results in significant symptom control, PPIs do not address the mechanical causes of the condition (Cadiere et al 2008a; Malik et al 2006). Furthermore, the inconvenience of long-term, daily medication may result in patient dissatisfaction and non-compliance (McLoughlin et al 2006).

The Nissen fundoplication procedure is the current gold standard treatment for GORD, with 89.5% of patients remaining symptom-free at 10 years (Bergman et al 2008). The procedure is often performed laparoscopically and involves wrapping the stomach around the lower oesophageal sphincter to strengthen the closing function of the sphincter

(preventing acid reflux) and to repair hiatal hernias. The procedure however, is associated with serious potential complications including dysphagia, bloating, nausea, vomiting and other symptoms related to vagal nerve injury (Waring et al 1999). Furthermore, while re-operation is possible, extensive scarring from the initial procedure makes re-operation more technically challenging.

Endoluminal fundoplication using the EsophyX device is a novel minimally invasive procedure. The procedure involves the insertion of the EsophyX device transorally, under direct endoscope visualisation, into the stomach to facilitate the reconstruction of the gastro-oesophageal valve (Cadiere et al 2006). The result is a 3 cm to 5 cm long omega-shaped valve with a 200° to 310° circumference. The device facilitates the creation of the valve by drawing gastric tissue from the fundus between the body of the device and the tissue mould used to shape each portion of the gastro-oesophageal valve. Multiple polypropylene fasteners are then delivered across the moulded tissue to create a serosa to serosa flap 3 cm to 5 cm long. The repair of hiatal hernias is achieved through a proprietary oesophageal invaginator incorporated into the device, which engages the distal oesophagus at the level of the Z line.

CLINICAL NEED AND BURDEN OF DISEASE

GORD is a common condition and accounts for approximately 75% of all oesophageal pathologic findings (Smith 2008). In Western countries it is estimated that the condition affects between 10% and 20% of the population (Dent et al 2005). Furthermore, approximately half of all GORD sufferers experience symptoms for more than 10 years (Dent et al 2005). No data regarding the incidence or prevalence of GORD in Australia was identified in the searches conducted.

Approximately 44% of Americans experience monthly heartburn with 18% of these requiring non prescription medications. GORD has a prevalence of approximately 19 million cases per year in the United States with a total cost of care of US\$9.8 billion (Richter 2007).

An endoluminal, minimally invasive approach to anti-reflux surgery, such as that presented by the EsophyX fundoplication procedure, has many potential advantages. These advantages may include leaving the gastro-oesophageal junction intact, the ability to perform the operation as an outpatient procedure, reduced operating time, a potential reduction in hospital costs and potential for future medical or surgical therapy.

DIFFUSION

The literature published for the use of the EsophyX system originates primarily from Europe. The EsophyX system received clearance from the United States Food and Drug Administration (FDA) in 2007 and has also received the European CE mark.

There is currently no literature documenting the use of the EsophyX system in Australia, and the device is not listed on the Australian Register of Therapeutic Goods (ARTG).

COMPARATORS

The gold standard surgical treatment for GORD is the Nissen fundoplication procedure. However, minimally invasive endoscopic techniques have been developed to address some of the complications and difficulties associated with surgery. These techniques can be divided into three categories: thermal ablation techniques, endoluminal gastric plication, and injection/implantation techniques:

Other endoscopic treatments for GORD include (McLoughlin et al 2006):

- Thermal ablation techniques: Stretta® Procedure (Curon® Medical, Inc., California, United States),
- Endoluminal gastric plication: Bard® EndoCinch™¹ (C.R. Bard, Inc., New Jersey, United States), Wilson-Cook Endoscopic Suturing Device (Wilson-Cook Medical, Inc., North Carolina, United States), NDO Plicator™ (NDO Surgical, Inc., Massachusetts, United States),
- Injection/implantation techniques: Enteryx® (Boston Scientific Corporation, Massachusetts, United States), Gatekeeper™ Reflux Repair System (Medtronic, Inc., Minnesota, United States) and Plexiglas®.

SAFETY AND EFFECTIVENESS ISSUES

Bergman et al (2008) reported on a retrospective study of eight (four male and four female) consecutive GORD patients (mean age 49 ± 21 years) who underwent endoluminal fundoplication using the second generation EsophyX device. Each patient had an American Society of Anaesthesia Index (ASA) ≤ 3 , and a body mass index (BMI) ≤ 40 kg/m², did not have had a hiatal hernia > 2 cm, and did not present with any severe gastro-oesophageal pathology or motility disorder. Seven patients were using PPI therapy prior to the procedure (one patient, intolerant to PPIs was taking antacids 10-15 times a day), four patients had small (≤ 2 cm) hiatal hernias and four had oesophagoduodenoscopy evidence of GORD.

Cadiere et al (2008a) reported the results of a prospective study involving nineteen consecutive patients who underwent endoluminal fundoplication using the EsophyX device. The patients presented with chronic (median duration 10 years; range: 3 to 15 years), symptomatic GORD, requiring daily PPI therapy (median time on PPI therapy 6 years; range: 2 to 13 years) with no evidence of oesophageal motility disorder. The presence of an oesophageal stricture in one patient and a 6 cm hiatal hernia in another led to the exclusion of two patients. Baseline assessment of GORD-HRQL and pH required patients to discontinue PPI therapy for at least seven days before measurements could be taken. However, due to the return of symptoms, baseline measurements were performed under PPI therapy. Following the procedure, patients were instructed to stop PPI therapy for seven days and contact the study coordinator in case of any complications or adverse events. In total, 17 patients (seven males and 10 females) with a median age of 34 years (range: 23 to 58 years) and a median BMI of 22 kg/m² (range: 18 to 31 kg/m²) were included.

¹ No longer on the market.

Cadiere et al (2008b) reported the results of a prospective multicentre study involving 86 patients (29 female and 57 male, median age 44 years) suffering chronic GORD (median duration 6 years) undergoing daily PPI therapy (median duration four years). Patients were responsive to PPI therapy, as indicated by GORD-HRQL scores of ≤ 12 ; however they experienced symptom recurrence upon discontinuation of PPI therapy for 14 days (GORD-HRQL score ≥ 20 or difference of ≥ 10 between the scores on and off PPIs). PPIs were discontinued for 14 days, and other GORD medications were discontinued for at least two days, prior to administration of the GORD-HRQL questionnaire. Seven days after surgery, patients were instructed to discontinue PPIs.

Safety

The mean procedural time reported by Bergman et al (2008) was 85 ± 30 minutes. During the peri-operative period, no complications were reported. During the postoperative follow-up period, at 60 ± 44 days following the procedure, Bergman et al (2008), recorded no postoperative adverse events. However, at seven days postoperatively, one patient experienced a sudden onset recurrence of heartburn. An oesophago-duodenoscopy revealed that the patient had lost more than half of the fasteners and had a gastro-oesophageal valve resembling his pre-procedural state. The aetiology of this finding was reported as unknown.

The median procedural time reported by Cadiere et al (2008a) was 123 minutes (range: 55 to 254 minutes). The authors reported no serious complications such as perforation, bleeding or death during the immediate perioperative period. On the first day following the procedure, 11 patients (65%) reported pharyngeal irritation resulting from device insertion and manipulation, however none complained of dysphagia. Mild epigastric pain was reported by all patients and treated with analgesics. One patient reported transient dysphonia. There was one readmission during the first postoperative week. This patient had air in the upper abdomen and had no evidence of perforation. The patient required no intervention and was discharged without further sequelae. Other adverse events including bloating, diarrhoea, difficulty swallowing, eructation, fever, flatulence, haematemesis, left shoulder pain, and nausea and vomiting were reported from the first postoperative day, however, their incidence decreased substantially during the first two postoperative weeks.

Cadiere et al (2008b) reported a median procedural time of 77 minutes (range: 28 to 208 minutes). A variety of non-serious adverse events, which resolved spontaneously, were reported by the authors. Musculoskeletal pain in the left shoulder for up to one month was the most common of these adverse events ($n = 8$). Musculoskeletal left shoulder pain was most likely a result of the requirement for patients to be positioned on their left side to conduct the procedure. Other adverse events which lasted for up to one month included upper abdominal pain in four (5%) patients, pharyngolaryngeal pain in one (1%) patient and epigastric pain in two (2%) patients. One case of upper abdominal pain (1%) and one case of nausea (1%) were reported to last over one month. Three serious adverse events were reported, including one case of perforation of the proximal oesophagus during advancement of the device without adequate visualisation, one case of perforation during an attempted device insertion into the narrow hypopharynx of a patient with Turner's syndrome and one case of post-procedural intraluminal bleeding with accompanying

decrease of haemoglobin of 70 g L^{-1} . In both perforation cases, the injury was able to be successfully repaired surgically. In the patient with intraluminal bleeding, the bleeding was able to be controlled by the use of clips and fibrin glue, as well as a blood transfusion.

Effectiveness

Bergman et al (2008) achieved a mean valve geometry of $238^\circ \pm 31^\circ$ with a mean valve length of $3.2 \pm 0.6 \text{ cm}$. Patients were instructed to stop PPI therapy seven days after the procedure unless symptoms persisted. The GORD health-related quality of life (GORD-HRQL) and symptom severity scale were then administered during the follow-up period between four and six weeks post-operatively (mean follow-up $60 \pm 44 \text{ days}$). The mean post-operative GORD-HRQL score was 8 ± 8 , while the postoperative mean severity score was 17 ± 15 . The baseline values for these parameters however, were not reported. At the time of follow-up, four patients (including the patient with lost fasteners) were on the same PPI dose as before the procedure. Additionally, these patients reported being either neutral or dissatisfied with their post-operative condition. Two patients no longer required PPI therapy and a further two were taking $\leq 50\%$ of their pre-operative PPI or antacid doses. These patients reported lower GORD-HRQL (3.3 ± 2.6 versus 12.5 ± 8.4 ; $p = 0.08$) and symptom severity scores (4.8 ± 4.8 versus 28.8 ± 11.2 ; $p = 0.01$), and were satisfied with their post-operative condition.

The patients reported by Cadiere et al (2008a) achieved a median immediate postoperative valve geometry and length of 210° (range: 180° to 270°) and 4 cm (range: 3 cm to 5 cm), respectively. At 12 months postoperatively, the median valve geometry and length was 200° (range: 150° to 210°) and 3 cm (range: 1 cm to 4 cm), respectively. During the baseline period, upper gastrointestinal endoscopy demonstrated evidence of reflux oesophagitis in all patients (13 patients grade A, two patients grade B and two patients grade C, according to the Los Angeles classification²). Postoperatively at 12 months, grade A or grade B oesophagitis was observed in 13 patients with no evidence of grade C oesophagitis in any patient. Similarly, during the baseline period, the natural gastro-oesophageal valves of all patients appeared loose around the endoscope. Immediately following the procedure, 14 valves were assessed as being tight around the endoscope, while three were assessed as moderate around the endoscope. At 12 months post-operatively, qualitative upper gastrointestinal endoscopic evaluation performed in 16 patients demonstrated that adherence of the gastro-oesophageal valve to the endoscope was tight in one patient, moderate in 12 patients and loose in three patients.

The primary end-point of the study was improvements of $\geq 50\%$ at 12 months in GORD-HRQL. Patients who met this criterion were considered to be responsive to the procedure. The median baseline GORD-HRQL was 17 (range: 12 to 31). At 12 months, all patients

² Los Angeles Classification of Oesophagitis:

Grade A - Mucosal break $\leq 5 \text{ mm}$ in length

Grade B - Mucosal break $> 5 \text{ mm}$ in length

Grade C - Mucosal break continuous between > 2 mucosal folds

Grade D - Mucosal break $\geq 75\%$ of oesophageal circumference

on PPIs discontinued medication for 15 days prior to the GORD-HRQL assessment. A significant ($p = 0.02$) 67% improvement in post-operative GORD-HRQL to a median of six was reported in the 17 patients. Nine patients (53%) recorded a GORD-HRQL score improvement of $\geq 50\%$.

Secondary end-points included improvement in the percentage of time at $\text{pH} < 4$ and a reduction in the use of PPIs. Fourteen patients (82%) were able to discontinue daily PPI therapy and 10 (63%) of the 16 patients who completed the 48 hour pH assessment demonstrated normal oesophageal acid exposure at 12 months post-operatively.

Success was defined as acid exposure equal to or less than 5.3% of time at $\text{pH} < 4$ (normal pH) and elimination of PPI therapy. Ten out of 16 patients and 14 out of 17 patients achieved normal pH and stopped PPI usage, respectively.

Preoperatively, thirteen (76%) patients had a reducible hiatal hernia (median size 2 cm; range: 1 cm to 3 cm). Following the procedure, all hiatal hernias had been completely reduced. At 12 months postoperatively, hiatal hernias remained reduced in 62% (8/13) of patients.

Follow-up at 12 months showed that 82% of patients were satisfied or very satisfied with the procedure.

Cadiere et al (2008b) reported a median valve length of 4 cm (2 cm to 6 cm) and geometry of 230° (160° to 300°). The authors reported that 81 (96%) patients at six months and 79 (94%) patients at 12 months were available for effectiveness analyses.

Prior to the procedure, the authors reported an increase in the median GORD-HRQL and heartburn scores upon discontinuation of daily PPIs from 9 (range: 0 to 22) to 24 (range: 11 to 38) and from 7 (range: 0 to 19) to 21 (range: 10 to 30) respectively. At six months postoperatively, patients reported a median reduction in GORD-HRQL of 80%, with a median GORD-HRQL score of 5 (range: 0 to 24), a statistically significant difference to the baseline score ($p < 0.0001$). At this time, 62 (77%) patients had recorded a clinically significant GORD-HRQL improvement of $\geq 50\%$. At 12 months, the median GORD-HRQL reduction was 68% (median GORD-HRQL: 7; range: 0 to 30), which was statistically significant when compared to the baseline score ($p < 0.0001$). At 12 months, the number of patients with a clinically significant reduction in GORD-HRQL score was 58 (73%).

The number of patients in whom complete postoperative GORD symptom elimination had occurred (GORD-HRQL score ≤ 12) was 65 (80%) at six months, and 59 (75%) patients at 12 months. The median post-operative reduction in GORD-HRQL in comparison to the baseline scores (while on PPIs) was 50% ($p < 0.05$) at six months, but decreased to 22% ($p = \text{NS}$) at 12 months.

The changes in heartburn score following the procedure were similar to those observed for the GORD-HRQL. The median heartburn score at 12 months was 6 (range: 0 to 26), a 67% reduction on baseline scores ($p < 0.0001$). When compared to the on PPIs baseline scores however, the median percentage reduction was significant at six months ($p < 0.05$), but not at 12 months.

At baseline, 8% of patients were taking a double dose of PPIs, 43% a full dose and 49% a half dose. At six months postoperatively, this reduced to 4% on double dose, 6% on full dose, 7% on half dose, and 14% on demand, while 69% ($n=81$) of patients were not taking any PPIs. At 12 months, 10% of patients were on full dose, 5% on half dose and 18% on demand, while 67% were no longer taking PPIs. Prior to the procedure, all patients were taking some sort of GORD medication daily. Postoperatively, at six months 14 (17%) patients required daily medication, 25 (31%) required occasional medication and 42 (52%) no longer required any GORD medication. At 12 months, 12 (15%) patients required daily medication, 29 (37%) required occasional medication and 38 (48%) no longer required medication.

At baseline, 58% of patients had a hiatal hernia with a median size of 1 cm (range: 1 cm to 3 cm). Following the procedure, all hiatal hernias were successfully reduced.

Prior to the procedure, the gastro-oesophageal valves were mostly Hill grade³ II (approximately 45%) or grade III (approximately 40%). At six months, this had improved to approximately 30% grade I, 55% grade II, 10% grade III and 5% grade IV. At 12 months, approximately 32% were grade I, 35% grade II, 25% grade III and 7% grade IV.

The mean baseline lower oesophageal sphincter resting pressure in 77 patients was 13.1 mmHg (range: 4 to 30 mmHg). Postoperatively in 75 patients, this significantly improved ($p < 0.01$) by 53% to 18.2 mmHg (range: 4 to 43).

Oesophageal acid exposure time was significantly reduced or normalised in 43 (61%) patients at 12 months postoperatively. This was equivalent to a median percentage reduction in time $\text{pH} < 4$ of 33% at 12 months ($p = 0.02$).

Based on the clinically significant reduction of heartburn, complete cessation of PPIs, and normalisation/significant reduction of oesophageal acid exposure in 80% of cases, 45 (56%) patients were considered to be cured. Of these cured patients, 19 (24%) patients were considered completely cured, defined by elimination of symptoms, oesophagitis and hiatal hernia as well as normalisation of oesophageal acid exposure. Twenty-two percent of patients were considered as improved, defined by 80% reduction in symptoms, cessation of daily PPIs, and reduced hiatal hernia or oesophagitis. The remaining 22% of

³ Hill grades:

Grade I valves – presence of prominent tissue fold surrounding the endoscope

Grade II valves – presence of moderately prominent tissue fold which rarely opens with respiration and closes promptly

Grade III valves – barely present fold which fails to close around the endoscope

Grade IV valves – absence of muscular fold. The lumen of the oesophagus remains open all the time allowing squamous epithelium to be viewed from the top.

patients were considered to have ongoing GORD, defined by the continuation of GORD symptoms and daily requirement for PPI therapy.

COST IMPACT

No cost information relating to the EsophyX system was identified from the retrieved studies.

ETHICAL, CULTURAL OR RELIGIOUS CONSIDERATIONS

No other issues were identified from the retrieved studies.

OTHER ISSUES

No other issues were identified from the retrieved studies.

SUMMARY OF FINDINGS

Endoluminal fundoplication using the EsophyX system results in gastro-oesophageal valves similar to that achieved with Nissen fundoplication. Evidence from the identified studies suggests that the device and the procedure are safe. However, while results in terms of the GORD-HRQL and other effectiveness measures appear favourable, there is a need for randomised controlled trials comparing endoluminal fundoplication using the EsophyX system to current standard medical and surgical treatment options.

HEALTHPACT ACTION

Based on the limited evidence available and the potential of the technology to provide a minimally invasive alternative to Nissen fundoplication, this technique is monitored for 12 months.

NUMBER OF STUDIES INCLUDED

Total number of studies 3
Level IV intervention evidence

REFERENCES

- Bergman S, Mikami D, Hazey J et al. Endoluminal fundoplication with EsophyX: The initial North American experience. *Surgical Innovation* 2008; 15(3): 166 – 170.
- Cadiere G, Rajan A, Rqibate M et al. Endoluminal fundoplication (ELF) – evolution of EsophyX, a new surgical device for transoral surgery. *Minimally Invasive Therapy* 2006; 15(6): 348 – 355.
- Cadiere G, Buset M, Muls V et al. Antireflux Transoral Incisionless fundoplication using EsophyX: 12-month results of a prospective multicenter study. *World Journal of Surgery* 2008b; 32(8): 1676 – 1688.
- Cadiere G, Rajan A, Germay O. Endoluminal fundoplication by a transoral device for the treatment of GERD: A feasibility study. *Surgical Endoscopy* 2008a; 22(2): 333 – 342.

Dent J, El-Serag H, Wallander M, Johansson S. Epidemiology of gastro-oesophageal reflux disease: a systematic review. *Gut* 2005; 54(5): 710-717.

Kaltenbach T, Crockett S, Gerson L. Are lifestyle measures effective in patients with gastroesophageal reflux disease? An evidence-based approach. *Archives of Internal Medicine* 2006; 166(9): 965 – 971.

Kahrilas P. Gastroesophageal reflux disease. *The New England Journal of Medicine* 2008; 359(16): 1700 – 1707.

Malik A, Mellinger J, Hazey J et al. Endoluminal and transluminal surgery: Current status and future possibilities. *Surgical Endoscopy* 2006; 20(8): 1179 – 1192.

McLoughlin P, Jamieson G, Maddern G. Endoscopic treatments for gastro-oesophageal reflux disease (GORD): an Accelerated Systematic Review. ASERNIP-S Review No 54. Adelaide, South Australia; ASERNIP-S, August 2006.

Piesman M, Hwang I, Maydonovitch C et al. Nocturnal reflux episodes following the administration of a standard meal. Does timing matter? *The American Journal of Gastroenterology* 2007; 102(10): 2128 – 2134.

Richter J. The many manifestations of gastroesophageal reflux disease: presentation, evaluation, and treatment. *Gastroenterology Clinics of North America* 2007; 36(3): 577-599.

Smith C. Antireflux surgery. *Surgical Clinics of North America* 2008; 88(5): 943 – 958.

Waring J. Postfundoplication complications. Prevention and management. *Gastroenterology Clinics of North America* 1999; 28(4): 1007 – 1019.

SEARCH CRITERIA TO BE USED

Fundoplication

Nissen fundoplication

GORD

GERD

Gastroesophageal reflux disease

Gastro-oesophageal reflux disease

Endoluminal

Minimally invasive

EsophyX

Transoral incisionless fundoplication

TIF