Magnetic Esophageal Sphincter Augmentation to Treat Gastroesophageal Reflux Disease (GERD)

Policy Number: 7.01.137  Last Review: 02/2018
Origination: 02/2014  Next Review: 02/2019

Policy
Blue Cross and Blue Shield of Kansas City (Blue KC) will not provide coverage Magnetic Esophageal Ring to Treat Gastroesophageal Reflux Disease (GERD). This is considered investigational.

When Policy Topic is covered
Not Applicable

When Policy Topic is not covered
Magnetic esophageal sphincter augmentation to treat gastroesophageal reflux disease (GERD) is investigational.

Description of Procedure or Service

<table>
<thead>
<tr>
<th>Populations</th>
<th>Interventions</th>
<th>Comparators</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals:</td>
<td>Interventions of interest are:</td>
<td>Comparators of interest are:</td>
<td>Relevant outcomes include:</td>
</tr>
<tr>
<td>• With gastroesophageal reflux disease</td>
<td>• Magnetic esophageal ring</td>
<td>• Continued medical therapy</td>
<td>• Symptoms</td>
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<tr>
<td></td>
<td></td>
<td>• Laparoscopic fundoplication</td>
<td>• Change in disease status</td>
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<td></td>
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<td>• Medication use</td>
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<td>• Treatment-related morbidity</td>
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A laparoscopically implanted ring composed of interlinked titanium beads with magnetic cores has been developed for the treatment of gastroesophageal reflux disease (GERD). The device is placed around the esophagus at the level of the gastroesophageal junction and is being evaluated in patients who have GERD symptoms despite maximum medical therapy.

For individuals who have GERD who receive magnetic sphincter augmentation (MSA), the evidence includes prospective and retrospective observational comparative studies, 2 single-arm interventional trials, and a number of single-
arm observational studies. Relevant outcomes are symptoms, change in disease status, medication use, and treatment-related morbidity. In the 2 single-arm, uncontrolled manufacturer-sponsored studies submitted to the U.S. Food and Drug Administration for device approval, subjects showed improvements in Gastroesophageal Reflux Disease–Health Related Quality of Life (GERD-HRQL) scores and reduced proton pump inhibitor (PPI) use. Similarly, observational comparative studies, most often comparing magnetic sphincter augmentation (MSA) with laparoscopic Nissen fundoplication, generally have shown that GERD-HRQL scores do not differ significantly between fundoplication and MSA, and patients are able to reduce PPI use after MSA. However, the comparative studies are retrospective and nonrandomized, may be affected by selection bias, and the subjective outcome measures used in these studies (eg, the GERD-HRQL scores) may be biased. A randomized trial is in progress; it will compare treatment with the MSA and treatment with double-dose PPIs. Randomized comparisons of MSA with laparoscopic Nissen fundoplication are also needed to evaluate the relative risk-benefit of these 2 procedures. The evidence is insufficient to determine the effects of the technology on health outcomes.

**Background**

**Gastroesophageal Reflux Disease**

Gastroesophageal reflux disease (GERD) is defined as reflux of stomach acid into the esophagus that causes symptoms and/or mucosal injury. GERD is a common medical disorder, with estimates of 10% to 20% prevalence in developed countries. The severity of GERD varies widely. Many patients have mild, intermittent symptoms that do not require treatment or only require episodic use of medications. Other patients have chronic, severe GERD that can lead to complications such as Barrett esophagus and esophageal cancer.

**Treatment**

For patients with severe disease, chronic treatment with acid blockers is an option. For some patients, medications are not adequate to control symptoms; other patients prefer to avoid the use of indefinite, possibly lifelong medications. Surgical treatments are available for these patients, primarily a Nissen fundoplication performed either laparoscopically or by open surgery. A number of less invasive procedures are also being evaluated as an intermediate option between medical therapy and surgery.

The LINX Reflux Management System is composed of a small flexible band of 10 to 18 interlinked titanium beads with magnetic cores. Using standard laparoscopic techniques, the band is placed around the esophagus at the level of the gastroesophageal junction. The magnetic attraction between the beads is intended to augment the lower esophageal sphincter to prevent gastric reflux into the esophagus, without compressing the esophageal wall. It is proposed that swallowing food or liquids creates sufficient pressure to overcome the magnetic bond between the beads, allowing the beads to separate and temporarily increase the size of the ring. The target population is patients who have GERD symptoms despite maximum medical therapy (eg, proton pump inhibitors) but who do not want to risk the adverse effects of a surgical procedure like Nissen fundoplication.
Adverse events of the LINX Reflux Management System may include dysphagia or odynophagia. The device can be removed by a laparoscopic procedure if severe adverse events occur or if magnetic resonance imaging is needed for another condition.

**Regulatory Status**
In 2012, the LINX™ Reflux Management System (Torax Medical, Shoreview, MN) was approved by the U.S. Food and Drug Administration through the premarket approval process for patients diagnosed with GERD, as defined by abnormal pH testing, and who continue to have chronic GERD symptoms despite maximal therapy for the treatment of reflux. The Food and Drug Administration initially required 5-year follow-up of 100 patients from the investigational device exemption pivotal study to evaluate safety and efficacy of the device, which was completed in March 2016. Food and Drug Administration product code: LEI.

**Rationale**
This evidence review was created in August 2012 and has been updated regularly with searches of the MEDLINE database. The most recent literature update was performed through September 11, 2017.

Randomized controlled trials (RCTs) are necessary to establish the efficacy of treatments for gastroesophageal reflux disease (GERD). GERD has a variable natural history, with exacerbations and remissions, and, as a result, a control group is required to differentiate improvements in symptoms from the natural history of the disorder. A placebo control is optimal due to the subjective nature of the patient-reported outcome measures, which are prone to bias if the patient is not blinded to treatment assignment. Random assignment is important because of the multiple potential confounders of GERD outcomes, such as diet, smoking, and obesity. Randomization minimizes the chance that these confounders will be distributed unequally among treatment groups. It is also important to determine comparative efficacy of treatments for GERD because numerous medical and surgical treatments are effective.

**Gastroesophageal Reflux Disease**
No RCTs were identified in the literature. Some nonrandomized comparative studies and case series were identified; they are reviewed next.

**Nonrandomized Comparative Studies**
Retrospective comparative studies have been identified on magnetic sphincter augmentation (MSA) with the LINX device compared with laparoscopic Nissen fundoplication (LNF) or laparoscopic Toupet fundoplication (LTF).

The largest study identified is a multi-institutional retrospective cohort study by Warren et al (2016) who reported on 415 patients treated with either MSA (n=201) or LNF (n=214). Eligible patients were retrospectively identified from 3 centers’ prospectively collected databases and met criteria if they had GERD at least partially responsive to proton pump inhibitor (PPI) treatment and positive pH
testing. MSA-treated patients had lower DeMeester scores, and lower rates of biopsy-proven Barrett esophagus and hiatal hernia. Given the differences in baseline groups, the authors used propensity score matching to generate 114 matched pairs based on preoperative esophagitis, presence of Barret esophagus, hiatal hernia, and body mass index. Mean follow-up differed for matched pair MSA (11 months) and LNF groups (16 months; p<0.001). In quality of life analysis at follow-up, there was no significant difference in match-pair groups in Gastroesophageal Reflux Disease–Health-Related Quality of Life (GERD-HRQL) scores (6 for MSA vs 5 for LNF, p=0.54). The proportion of patients using PPIs at follow-up was higher in the MSA group (24% vs 12%, p=0.02), but more patients in the MSA group had the ability for eructation (97% vs 66%, p<0.001).

Also in 2016, Asti et al reported on an observational cohort study comparing MSA (n=135) and LTF (n=103), using patients identified from a prospectively collected database. Eligible patients had GERD symptoms despite PPI for at least 6 months and normal esophageal motility. In a generalized estimating equation model for the GERD-HRQL, there was no significant difference at 1 year in GERD-HRQL scores between MSA and LTF groups (odds ratio for time-treatment interaction term, 1.04; 95% confidence interval [CI], 0.89 to 1.27; p=0.578). Similarly, there was no significant difference between the MSA and LTF groups at 1 year in PPI use (odds ratio for time-treatment interaction term, 1.18; 95% CI, 0.81 to 1.70; p=0.389).

Reynolds et al (2015) reported on 1-year follow-up for 50 MSA and 50 LNF patients matched by disease severity. To be included in the study, patients had (1) objective evidence of GERD, defined as an abnormal pH study, presence of biopsy-proven Barrett esophagus, or esophagitis grade B or greater; (2) PPI therapy for a minimum of 6 months; and (3) normal esophageal motility. Some patients had been included in previous reports. At 1 year after surgery, the 2 groups had similar GERD-HRQL scores (MSA=4.2 vs LNF=4.3; maximum, 50) and PPI use (MSA=17% vs LNF=8.5%). There was no difference in the number of patients reporting mild gas and bloating (MSA=27.6% vs LNF=27.6%), but more LNF patients reported severe gas and bloating (10.6% vs 0%, p=0.028). More LNF patients were unable to belch (MSA=8.5% vs LNF=25.5%, p=0.028) or vomit when needed (MSA=4.3% vs LNF=21.3%, p<0.002).

Louie et al (2014) compared outcomes from 34 patients who had MSA with 32 patients who underwent LNF. Similar improvements were found for both groups on the GERD-HRQL. The DeMeester score and pH normalized in both groups, but both were lower (p=0.001) in the fundoplication group. MSA allowed belching in 67% of patients compared with 0% in the fundoplication group. Sheu et al (2014) retrospectively compared outcomes from 12 MSA patients with a contemporaneous case-matched cohort of patients who underwent LNF. Over half of the MSA patients were self-referred compared with none who underwent LNF. Both procedures were effective for reflux. Severe dysphagia requiring endoscopic dilation was more frequent after MSA (50% of cases), while there was a trend for a reduction in bloating, flatulence, and diarrhea in this study.
In 2015, Riegler et al published 1-year results from an industry-sponsored multicenter registry (NCT01624506) that included a comparison with laparoscopic fundoplication.\(^6\) The report included 202 MSA and 47 LNF or LTF patients from a planned enrollment of 734 patients. The choice of procedure was made by the surgeon at the time of laparoscopy, taking into account the presence of a large hiatal hernia and other factors. In addition to having a greater frequency of large hiatal hernias (>3 cm, 45.7% vs 1.6%), the fundoplication group was older and had a greater frequency of Barrett esophagus (19.1% vs 1.0%, \(p<0.001\)). Consistent with the greater severity of symptoms, patients who underwent fundoplication had greater regurgitation and fewer discontinued PPIs after treatment. Excessive gas and abdominal bloating (31.9% vs 10.0%) and inability to vomit (55.6% vs 8.7%) were significantly higher after fundoplication than after MSA. Improvements in GERD-HRQL scores were similar for the 2 groups.

**Section Summary: Nonrandomized Comparative Studies**

Observational comparative studies, most often comparing MSA with LNF, have generally shown that GERD-HRQL scores do not differ significantly between fundoplication and MSA, and patients can reduce PPI use after MSA. However, these studies are limited by differences in baseline characteristics of patients treated with MSA and fundoplication. Some studies adjusted for some differences by matching for patient characteristics in their analyses, although the potential for residual confounding remains.

**Single-Arm Studies**

Data submitted to the U.S. Food and Drug Administration for the LINX Reflux Management System included 2 single-arm Food and Drug Administration–regulated investigational device exemption (IDE) trials (total \(N=144\) subjects) and follow-up data between 2 and 4 years.\(^7\) The feasibility IDE trial enrolled 44 subjects at 4 clinical sites (2 U.S., 2 Europe) and had published data out to 4 years.\(^8,9\) The pivotal IDE trial included 100 subjects from 14 clinical sites (13 U.S., 1 Europe) who had documented symptoms of GERD for more than 6 months (regurgitation or heartburn that responds to acid neutralization or suppression), required daily PPI or other antireflux drug therapy, had symptomatic improvement on PPI therapy, and had a total distal ambulatory esophageal pH less than 4 for 4.5% or more of the time when off GERD medications. The primary safety end point measured the rate of related device and procedure serious adverse events. Efficacy end points were assessed off PPI therapy and measured esophageal acid exposure, total GERD-HRQL scores, and PPI usage. Subjects served as their own controls.

Results of the pivotal trial were published in 2013.\(^10\) In this trial, the primary efficacy end point of pH normalization or reduction of 50% or more in acid exposure time when off PPI was met by 64% of the subjects. Mean total acid exposure time was reduced from 11.6% at baseline to 5.1% at 12 months (56% reduction). The secondary efficacy end points met the study success criteria. Ninety-two percent of subjects had at least a 50% improvement in GERD-HRQL score (the mean GERD-HRQL total score decreased from 28.4 at baseline to 5.9 and 5.5 at 12 and 24 months, respectively), and 93% had reduced PPI use (79%
and 83% of subjects were free from daily dependence at 12 and 24 months, respectively, vs 0% at baseline). Dysphagia was observed in 68% of patients postoperatively, in 11% at 1 year, and in 4% at 3 years. Nineteen patients underwent esophageal dilation for dysphagia. Six (6%) patients experienced a serious adverse event including severe dysphagia and vomiting. The device was removed from 4 of these 6 patients with a serious adverse event and in two others for persistent reflux and chest pain.

Five-year results from 33 of the 44 patients from the feasibility IDE trial were published in 2015. For the 33 with follow-up, the mean total GERD-HRQL score decreased from 25.7 at baseline to 2.9 at year 5 (p<0.001); 93.9% had more than 50% reduction in total score vs baseline. On esophageal pH testing, the mean percentage of time that pH was less than 4 decreased from 11.9% at baseline to 4.6% at 5 years (p<0.001). At 5 years, 87.8% had stopped PPIs.

Five-year results for the 100 patients in the pivotal IDE trial were published in 2016. Eighty-five patients had follow-up at 5 years. Of those 85, 83% achieved had a 50% reduction in GERD-HRQL scores (95% CI 73% to 91%), and 89.4% had a reduction of 50% or more in average daily dose of PPI (95% CI, 81% to 95%). No new major safety concerns emerged. The device was removed in 7 patients.

In 2013, Bonavina et al published longer follow-up from patients in the pilot and multicenter registry studies. This study included a consecutive series of 100 patients who received MSA for GERD at their institution and were followed for a median of 3 years (range, 378 days to 6 years). Thirty of the patients had data beyond 5 years. Median GERD-HRQL score improved from 24 off PPIs to 2 (p<0.001), and freedom from daily dependence on PPIs was achieved in 85% of patients. The time that esophageal pH was less than 4 decreased from 8.0% to 3.2% (p<0.001). Although 3 patients had the device removed for persistent GERD, odynophagia, or dysphagia, no occurrences of device migrations or erosions were observed during follow-up.

In 2015, Lipham et al reported on adverse events for the first 1048 implanted patients (82 institutions). Of these, 144 were implanted as part of premarket clinical trials (previously described), 332 had been enrolled in the postmarket registry, and 572 were implanted outside of a postmarket registry. The three sources used to identify adverse events were the published clinical literature along with the device’s Summary of Safety Effectiveness Data, the Food and Drug Administration database for device-related complications (MAUDE database), and information provided by the manufacturer. Event rates were 0.1% intra- or perioperative complications, 1.3% hospital readmissions, 5.6% endoscopic dilations, and 3.4% reoperations for device removal. The primary reason for device removal was dysphagia. Erosion of the device occurred in 1 (0.1%) patient. Median device implantation was 274 days. This study was limited by the short follow-up and the voluntary reporting of adverse events outside of the registry.
Additional single-arm observational studies have reported on outcomes after MSA in sample sizes ranging from 121 to 192 patients, some of which focused on specific subpopulations of individuals with GERD, such as those with large hiatal hernias (eg, Rona et al, 2017).

**Summary of Evidence**

For individuals who have GERD who receive MSA, the evidence includes prospective and retrospective observational comparative studies, 2 single-arm interventional trials, and a number of single-arm observational studies. Relevant outcomes are symptoms, change in disease status, medication use, and treatment-related morbidity. In the 2 single-arm, uncontrolled manufacturer-sponsored studies submitted to the U.S. Food and Drug Administration with materials for device approval, subjects showed improvements in GERD-HRQL scores and reduced proton pump inhibitor use. Similarly, observational comparative studies, most often comparing MSA with laparoscopic Nissen fundoplication, generally have shown that GERD-HRQL scores do not differ significantly between fundoplication and MSA, and patients can reduce proton pump inhibitor use after MSA. However, the comparative studies are retrospective and nonrandomized, may be affected by selection bias, and the subjective outcome measures used in these studies (eg, the GERD-HRQL scores) may be biased. A randomized trial is in progress (NCT02505945); it will compare treatment with the MSA and treatment with double-dose proton pump inhibitors. Randomized comparisons of MSA with laparoscopic Nissen fundoplication are also needed to evaluate the relative risk-benefit of these 2 procedures. The evidence is insufficient to determine the effects of the technology on health outcomes.

**Supplemental Information**

**Practice Guidelines and Position Statements**

**Society of American Gastrointestinal and Endoscopic Surgeons**

In 2013, the Society of American Gastrointestinal and Endoscopic Surgeons published guidelines on the safety and effectiveness of the LINX Reflux Management System. The Society indicated that safety analyses of the LINX system suggested the procedure is associated with few serious adverse events and no reported mortality, and that currently available data demonstrated a reasonable assurance as to the efficacy of the system. The guidelines concluded that direct comparative studies between the LINX procedure and Nissen fundoplication would be needed, although, based on the available evidence, the LINX device should be an option available to patients and providers for the management of medically refractory gastroesophageal reflux disease.

**American Society for Gastrointestinal Endoscopy**

A 2017 report from the American Society for Gastrointestinal Endoscopy concluded that long-term data on the safety and efficacy of the LINX device were needed. The document indicated that the LINX band is currently being deployed laparoscopically; however, a natural orifice transluminal endoscopic surgery approach could be explored.
U.S. Preventive Services Task Force Recommendations
Not applicable.

Medicare National Coverage
There is no national coverage determination. In the absence of a national coverage determination, coverage decisions are left to the discretion of local Medicare carriers.

Ongoing and Unpublished Clinical Trials
Some currently unpublished trials that might influence this review are listed in Table 1.

Table 1. Summary of Key Trials

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
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<td>Ongoing</td>
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<tr>
<td>NCT02505945a</td>
<td>The CALIBER Study Randomized Controlled Trial of LINX Versus Double-Dose Proton Pump Inhibitor Therapy for Reflux Disease</td>
<td>150</td>
<td>Jun 2018</td>
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<tr>
<td>NCT01940185a</td>
<td>A Post-Approval Study of the Lynx® Reflux Management System</td>
<td>200</td>
<td>Sep 2019</td>
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</table>

NCT: national clinical trial.

Denotes industry-sponsored or cosponsored trial.

References

Billing Coding/Physician Documentation Information

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>43284</td>
<td>Laparoscopy, surgical, esophageal sphincter augmentation procedure, placement of sphincter augmentation device (ie, magnetic band), including cruroplasty when performed (New Code 1/1/2017)</td>
</tr>
<tr>
<td>43285</td>
<td>Removal of esophageal sphincter augmentation device (New Code 1/1/2017)</td>
</tr>
</tbody>
</table>

ICD-10 Codes

K21.0, K21.9  Gastro-esophageal reflux disease with and without esophagitis code range

The Medicare carrier Novitas Solutions posted a provider bulletin in June 2013 which states that code 43280 has been incorrectly reported for this procedure and that the unlisted code 43289 should be used (https://www.novitas-solutions.com/bulletins/all/news-06192013.html).

0392T, 0393T deleted as of 1/1/2017)
C9737 was deleted 7/1/2015.

Additional Policy Key Words
Policy Implementation/Update Information

2/1/2014  New Policy; considered investigational.
2/1/2015  Added HCPCS code. No policy statement changes.
2/1/2016  Added CPT Codes. No policy statement changes.
2/1/2017  “Magnetic esophageal ring” changed to “magnetic sphincter augmentation” in policy statement; policy statement otherwise unchanged; title changed to “Magnetic Esophageal Sphincter Augmentation to Treat Gastroesophageal Reflux Disease”
2/1/18    No policy statement changes.

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