Title: Interspinous and Interlaminar Stabilization / Distraction Devices (Spacers)

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<table>
<thead>
<tr>
<th>Populations</th>
<th>Interventions</th>
<th>Comparators</th>
<th>Outcomes</th>
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</thead>
<tbody>
<tr>
<td>Individuals: • With spinal stenosis and no spondylolisthesis or grade 1 spondylolisthesis who failed conservative treatment</td>
<td>Interventions of interest are: • Interspinous or interlaminar spacer as a stand-alone procedure</td>
<td>Comparators of interest are: • Lumbar spinal decompression surgery</td>
<td>Relevant outcomes include: • Symptoms • Functional outcomes • Quality of life • Treatment-related morbidity</td>
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DESCRIPTION
Interspinous and interlaminar implants (spacers) stabilize or distract the adjacent lamina and/or spinous processes and restrict extension to reduce pain in patients with lumbar spinal stenosis and neurogenic claudication. Interspinous spacers are small devices implanted between the vertebral spinous processes. After implantation, the device is opened or expanded to distract (open) the neural foramen and decompress the nerves. Interlaminar spacers are implanted midline between adjacent lamina and spinous processes to provide dynamic stabilization either following decompression surgery or as an alternative to decompression surgery.

OBJECTIVE
The objective of this policy is to determine whether the use of an interspinous distraction device or interlaminar stabilization device improves the net health outcome in patients with lumbar spinal stenosis.

BACKGROUND
Spinal Stenosis
Lumbar spinal stenosis (LSS), which affects over 200,000 people in the United States, involves a narrowed central spinal canal, lateral spinal recesses, and/or neural foramina, resulting in pain as well as limitation of activities such as walking, traveling, and standing. In adults over 60 in the United States, spondylosis (degenerative arthritis affecting the spine) is the most common cause. The primary symptom of LSS is neurogenic claudication with back and leg pain, sensory loss, and weakness in the legs. Symptoms are typically exacerbated by standing or walking and relieved with sitting or flexion at the waist.

Some sources describe the course of LSS as “progressive” or “degenerative,” implying that neurologic decline is the usual course. Longer term data from the control groups of clinical trials as well as from observational studies suggest that, over time, most patients remain stable, some improve, and some deteriorate.1, 2,

<table>
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<tr>
<td>Individuals:</td>
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<td>Relevant outcomes include:</td>
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<tr>
<td>• With severe spinal stenosis and grade 1 spondylolisthesis who failed conservative treatment</td>
<td>Interventions of interest are: • Interlaminar spacer with spinal decompression surgery</td>
<td>Comparators of interest are: • Lumbar spinal decompression alone • Lumbar spinal decompression with spinal fusion</td>
<td>• Symptoms • Functional outcomes • Quality of life • Treatment-related morbidity</td>
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<tr>
<td>Individuals:</td>
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<td>Relevant outcomes include:</td>
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<tr>
<td>• With spinal stenosis and no spondylolisthesis or instability who failed conservative treatment</td>
<td>Interventions of interest are: • Interlaminar spacer with spinal decompression surgery</td>
<td>Comparators of interest are: • Lumbar spinal decompression alone</td>
<td>• Symptoms • Functional outcomes • Quality of life • Treatment-related morbidity</td>
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The lack of a valid classification for LSS contributes to wide practice variation and uncertainty about who should be treated surgically and which surgical procedure is best for each patient.3, 4 This uncertainty also complicates research on spinal stenosis, particularly the selection of appropriate eligibility criteria and comparators.5

**Treatment**

The largest group of patients with spinal stenosis is minimally symptomatic patients with mild back pain and no spinal instability. These patients are typically treated nonsurgically. At the other end of the spectrum are patients who have severe stenosis, concomitant back pain, and grade 2 or higher spondylolisthesis or degenerative scoliosis >25 Cobb angle who require laminectomy plus spinal fusion.

Surgical treatment for spinal stenosis may include physical therapy, pharmacotherapy, epidural steroid injections, and many other modalities.6 The terms “nonsurgical” and “nonoperative” have also been used to describe conservative treatment. Professional societies recommend that surgery for LSS should be considered only after a patient fails to respond to conservative treatment, but there is no agreement about what constitutes an adequate course or duration of treatment.

The term “conservative management” may refer to “usual care” or to specific programs of nonoperative treatment, which use defined protocols for the components and intensity of conservative treatments, often in the context of an organized program of coordinated, multidisciplinary care. The distinction is important in defining what constitutes a failure of conservative treatment and what comparators should be used in trials of surgical vs nonsurgical management. The rationale for surgical treatment of symptomatic spinal stenosis rests on the Spine Patient Outcomes Research Trial (SPORT), which found that patients who underwent surgery for spinal stenosis and spondylolisthesis had better outcomes than those treated nonoperatively. The SPORT investigators did not require a specified program of nonoperative care but rather let each site decide what to offer.7 A subgroup analysis of the SPORT trial found that only 37% of nonsurgically treated patients received physical therapy in the first 6 weeks of the trial and that those who received physical therapy before 6 weeks had better functional outcomes and were less likely to cross over to surgery later.8 These findings provide some support for the view that, in clinical trials, patients who did not have surgery may have had suboptimal treatment, which can lead to a larger difference favoring surgery. The SPORT investigators asserted that their nonoperative outcomes represented typical results at a multidisciplinary spine center at the time, but recommended that future studies compare the efficacy of specific nonoperative programs to surgery.

A recent trial by Delitto et al (2015) compared surgical decompression with a specific therapy program emphasizing physical therapy and exercise.9 Patients with lumbar spinal stenosis and from 0 to 5 mm of slippage (spondylolisthesis) who were willing to be randomized to decompression surgery vs an intensive, organized program of nonsurgical therapy were eligible. Oswestry Disability Index scores were comparable to those in the
SPORT trial. A high proportion of patients assigned to nonsurgical care (57%) crossed over to surgery (in SPORT the proportion was 43%), but crossover from surgery to nonsurgical care was minimal. When analyzed by treatment assignment, Oswestry Disability Index scores were similar in the surgical and nonsurgical groups after 2 years of follow-up. The main implication is that about one-third of patients who were deemed candidates for decompression surgery but instead entered an intensive program of conservative care achieved outcomes similar to those of a successful decompression.10,

Diagnostic criteria for fusion surgery are challenging because patients without spondylolisthesis and those with grade 1 spondylolisthesis are equally likely to have predominant back pain or predominant leg pain.11, The SPORT trial did not provide guidance on which surgery is appropriate for patients who do not have spondylolisthesis, because nearly all patients with spondylolisthesis underwent fusion whereas nearly all those who did not have spondylolisthesis underwent decompression alone. In general, patients with predominant back pain have more severe symptoms, worse function, and less improvement with surgery (with or without fusion). Moreover, because back pain improved to the same degree for the fused spondylolisthesis patients as for the unfused spinal stenosis patients at 2 years, the SPORT investigators concluded that it was unlikely that fusion led to the better surgical outcomes in patients with spondylolisthesis than those with no spondylolisthesis.12, 13,

Throughout the 2000s, decompression plus fusion became more widely used until, in 2011, it surpassed decompression alone as a surgical treatment for spinal stenosis.14, 15, 16, However, in 2016, findings from two randomized trials of decompression alone vs decompression plus fusion were published. The Swedish Spinal Stenosis Study (SSSS) found no benefit of fusion plus decompression compared with decompression alone in patients who had spinal stenosis with or without degenerative spondylolisthesis.17, The Spinal Laminectomy versus Instrumented Pedicle Screw (SLIP) trial found a small but clinically meaningful improvement in the Physical Component Summary score of the 36-Item Short-Form Health Survey but no change in Oswestry Disability Index scores at 2, 3, and 4 years in patients who had spinal stenosis with grade 1 spondylolisthesis (3-14 mm).18, The patients in SLIP who had laminectomy alone had higher reoperation rates than those in SSSS, and the patients who underwent fusion had better outcomes in SLIP than in SSSS. While some interpret the studies to reflect differences in patient factors—in particular, SSSS but not SLIP included patients with no spondylolisthesis, the discrepancy may also be influenced by factors such as time of follow-up or national practice patterns.19, 20, 21, 22, 23, 24, As Pearson (2016) noted, it might have been helpful to have patient-reported outcome data on the patients before and after reoperation, to see whether the threshold for reoperation differed in the 2 settings.25, A small trial conducted in Japan, Inose et al (2018) found no difference in patient-reported outcomes between laminectomy alone and laminectomy plus posterolateral fusion in patients with 1-level spinal stenosis and grade 1 spondylolisthesis; about 40% of the patients also had dynamic instability.26, Certainty in the findings of this trial is limited because of its size and methodologic flaws.
Spacer Devices
Investigators have sought less invasive ways to stabilize the spine and reduce the pressure on affected nerve roots, including interspinous and interlaminar implants (spacers). These devices stabilize or distract the adjacent lamina and/or spinous processes and restrict extension in patients with lumbar spinal stenosis and neurogenic claudication.

Interspinous Implants
Interspinous spacers are small devices implanted between the vertebral spinous processes. After implantation, the device is opened or expanded to distract the neural foramina and decompress the nerves. One type of interspinous implant is inserted between the spinous processes through a small (4-8 cm) incision and acts as a spacer between the spinous processes, maintaining flexion of that spinal interspace. The supraspinous ligament is maintained and assists in holding the implant in place. The surgery does not include any laminotomy, laminectomy, or foraminotomy at the time of insertion, thus reducing the risk of epidural scarring and cerebrospinal fluid leakage. Other interspinous spacers require removal of the interspinous ligament and are secured around the upper and lower spinous processes.

Interlaminar Spacers
Interlaminar spacers are implanted midline between adjacent lamina and spinous processes to provide dynamic stabilization either following decompression surgery or as an alternative to decompression surgery. Interlaminar spacers have 2 sets of wings placed around the inferior and superior spinous processes. They may also be referred to as interspinous U. These implants aim to restrict painful motion while enabling normal motion. The devices (spacers) distract the laminar space and/or spinous processes and restrict extension. This procedure theoretically enlarges the neural foramen and decompresses the cauda equina in patients with spinal stenosis and neurogenic claudication.

REGULATORY STATUS
Three interspinous and interlaminar stabilization and distraction devices have been approved by Food Drug Administration (FDA) through the premarket approval (FDA product code: NQO) are summarized in Table 1.

Table 1. Interspinous and Interlaminar Stabilization/Distraction Devices with Premarket Approval

<table>
<thead>
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<th>Device Name</th>
<th>Manufacturer</th>
<th>Approval Date</th>
<th>PMA</th>
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<tbody>
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<td>Coflex® Interlaminar Technology</td>
<td>Paradigm Spine</td>
<td>2012</td>
<td>P110008</td>
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<tr>
<td>Superion® Indirect Decompression System (previously Superion Interspinous Spacer)</td>
<td>VertiFlex</td>
<td>2015</td>
<td>P14004</td>
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PMA: premarket approval.
The Superion® Indirect Decompression System (formerly InterSpinous Spacer) is indicated to treat skeletally mature patients suffering from pain, numbness, and/or cramping in the legs secondary to a diagnosis of moderate degenerative lumbar spinal stenosis, with or without grade 1 spondylolisthesis, confirmed by x-ray, magnetic resonance imaging, and/or computed tomography evidence of thickened ligamentum flavum, narrowed lateral recess, and/or central canal or foraminal narrowing. It is intended for patients with impaired physical function who experience relief in flexion from symptoms of leg/buttock/groin pain, numbness, and/or cramping, with or without back pain, and who have undergone at least 6 months of nonoperative treatment.

FDA lists the following contraindications to use of the Superion® Indirect Decompression System:
- “An allergy to titanium or titanium alloy.
- Spinal anatomy or disease that would prevent implantation of the device or cause the device to be unstable in situ, such as:
  - Instability of the lumbar spine, e.g., isthmic spondylolisthesis or degenerative spondylolisthesis greater than grade 1 (on a scale of 1 to 4)
  - An ankylosed segment at the affected level(s)
  - Fracture of the spinous process, pars interarticularis, or laminae (unilateral or bilateral);
  - Scoliosis (Cobb angle >10 degrees)
- Cauda equina syndrome defined as neural compression causing neurogenic bladder or bowel dysfunction.
- Diagnosis of severe osteoporosis, defined as bone mineral density (from DEXA dual-energy x-ray absorptiometry, scan or equivalent method) in the spine or hip that is more than 2.5 S.D. below the mean of adult normal.
- Active systemic infection, or infection localized to the site of implantation.
- Prior fusion or decompression procedure at the index level.
- Morbid obesity defined as a body mass index (BMI) greater than 40.”

The coflex® Interlaminar Technology implant (Paradigm Spine) is a single-piece U-shaped titanium alloy dynamic stabilization device with pairs of wings that surround the superior and inferior spinous processes. The coflex® (previously called the Interspinous U) is indicated for use in 1- or 2-level lumbar stenosis from the L1 to L5 vertebrae in skeletally mature patients with at least moderate impairment in function, who experience relief in flexion from their symptoms of leg/buttocks/groin pain, with or without back pain, and who have undergone at least 6 months of nonoperative treatment. The coflex® “is intended to be implanted midline between adjacent lamina of 1 or 2 contiguous lumbar motion segments. Interlaminar stabilization is performed after decompression of stenosis at the affected level(s).”
FDA lists the following contraindications to use of the coflex®:

- “Prior fusion or decompressive laminectomy at any index lumbar level.
- Radiographically compromised vertebral bodies at any lumbar level(s) caused by current or past trauma or tumor (e.g., compression fracture).
- Severe facet hypertrophy that requires extensive bone removal which would cause instability.
- Grade II or greater spondylolisthesis.
- Isthmic spondylolisthesis or spondylolysis (pars fracture).
- Degenerative lumbar scoliosis (Cobb angle greater than 25).
- Osteoporosis.
- Back or leg pain of unknown etiology.
- Axial back pain only, with no leg, buttock, or groin pain.
- Morbid obesity defined as a body mass index > 40.
- Active or chronic infection systemic or local.
- Known allergy to titanium alloys or MR magnetic resonance, contrast agents.
- Cauda equina syndrome defined as neural compression causing neurogenic bowel or bladder dysfunction.”

The FDA labeling also contains multiple precautions and the following warning: “Data has demonstrated that spinous process fractures can occur with coflex® implantation.”

At the time of approval, FDA requested additional postmarketing studies to provide longer-term device performance and device performance under general conditions of use. The first was the 5-year follow-up of the pivotal investigational device exemption trial. The second was a multicenter trial with 230 patients in Germany who were followed for 5 years, comparing decompression alone with decompression plus coflex®. The third, a multicenter trial with 345 patients in the United States who were followed for 5 years, compared decompression alone with decompression plus coflex®.27, FDA product code: NQO.
POLICY
A. Interspinous or interlaminar distraction devices as a stand-alone procedure are considered experimental / investigational as a treatment of spinal stenosis.

B. Use of an interlaminar stabilization device following decompression surgery is considered experimental / investigational.

RATIONALE
This evidence review has been updated with searches of the MEDLINE database. The most recent literature update was performed through July 9, 2019.

The following conclusions are based on a review of the evidence, including, but not limited to, published evidence and clinical expert opinion, via BCBSA's Clinical Input Process.

Evidence reviews assess the clinical evidence to determine whether the use of technology improves the net health outcome. Broadly defined, health outcomes are the length of life, quality of life (QOL), and ability to function—including benefits and harms. Every clinical condition has specific outcomes that are important to patients and managing the course of that condition. Validated outcome measures are necessary to ascertain whether a condition improves or worsens; and whether the magnitude of that change is clinically significant. The net health outcome is a balance of benefits and harms.

To assess whether the evidence is sufficient to draw conclusions about the net health outcome of technology, two domains are examined: the relevance, and quality and credibility. To be relevant, studies must represent one or more intended clinical use of the technology in the intended population and compare an effective and appropriate alternative at a comparable intensity. For some conditions, the alternative will be supportive care or surveillance. The quality and credibility of the evidence depend on study design and conduct, minimizing bias and confounding that can generate incorrect findings. The randomized controlled trial (RCT) is preferred to assess efficacy; however, in some circumstances, nonrandomized studies may be adequate. RCTs are rarely large enough or long enough to capture less common adverse events and long-term effects. Other types of studies can be used for these purposes and to assess generalizability to broader clinical populations and settings of clinical practice.

The largest group of patients with spinal stenosis is minimally symptomatic patients with mild back pain and no spinal instability. These patients are typically treated nonsurgically. At the other end of the spectrum are patients who have severe stenosis, concomitant back pain, and grade 2 or higher spondylolisthesis, spinal instability, or degenerative scoliosis >25 Cobb angle who require laminectomy plus spinal fusion.

The literature is dominated by reports from non-U.S. centers evaluating devices not approved by the U.S. Food and Drug Administration (FDA), although a number of them are in trials at U.S. centers. As of April 2018, only the X-STOP, coflex, and Superion Interspinous Spacer (ISS) devices had received the FDA approval for use in the U.S. Manufacturing of the X-STOP device stopped in 2015. This review focuses on devices currently available for use in the United States.
Interspinous or Interlaminar Spacer as a Stand-Alone Treatment

Clinical Context and Therapy Purpose
The purpose of the interspinous or interlaminar spacer in patients with spinal stenosis and no spondylolisthesis or grade 1 spondylolisthesis is to provide a treatment option that is better than lumbar spinal decompression surgery. Although not tested in trials, another potential purpose could be to provide an alternative to conservative therapy in patients who are medically unsuitable for undergoing general anesthesia for more invasive lumbar surgery or nonsurgical conservative therapy.

The question addressed in this evidence review is: Does the use of an interspinous or interlaminar spacer in patients with spinal stenosis and no spondylolisthesis or grade 1 spondylolisthesis, when used as a stand-alone treatment, improve the net health outcome?

The following PICOs were used to select literature to inform this review.

Patients
The relevant population of interest are patients with spinal stenosis and no spondylolisthesis or grade 1 spondylolisthesis.

Interventions
The treatment being considered is the placement of an interspinous or interlaminar spacer as a stand-alone treatment.

Comparators
The following practices are currently being used to treat with spinal stenosis with no spondylolisthesis or grade 1 spondylolisthesis: lumbar spinal decompression surgery and nonsurgical conservative therapy.

Outcomes
The general outcome of interest is whether the placement of an interspinous or interlaminar spacer improves function as measured by a 15-point improvement in the Oswestry Disability Index (ODI) scores. Other measures such as 36-Item Short-Form Health Survey to assess the QOL, Zurich Claudication Questionnaire (ZCQ) also to assess QOL for patients with lumbar spinal stenosis (LSS), and freedom from secondary interventions are also of interest to determine whether placement of an interspinous or interlaminar spacer improves the net health outcome. In addition, the adverse events of treatment need assessment. The window to judge treatment success is a minimum of two years postprocedure.

Zurich Claudication Questionnaire (ZCQ)
The ZCQ was designed specifically for use in the evaluation of physical function in patients with LSS. Subscales of the questionnaire may be used separately. For example, the 5-item Physical Function Scale is used primarily to evaluate walking capacity. These five items assess distance walked and activities of daily living involving walking. The Physical Function Scale has been used to assess walking as an outcome for surgical and nonsurgical treatment in patients with LSS.
The Zurich Claudication Questionnaire consists of three subscales:
1. Symptom severity scale (questions I-VII) [further subdivided into pain domain (questions I-IV) and a neuro-ischemic domain (questions V-VII)]: Possible range of the score is 1 to 5.
2. Physical function scale (questions VIII-XII): Possible range of scores is 1 to 4.
3. Patient’s satisfaction with treatment scale (questions XIII-XVIII): The range of the scale is 1 to 4.

**Scoring Method / Interpretation**
The result is expressed as a percentage of the maximum possible score. The score increases with worsening disability.

**Oswestry Disability Index (ODI)**
The ODI is a self-administered questionnaire used by clinicians and researchers to quantify disability for low back pain. The maximum score is 50. The Minimum Detectable Change (at 90% confidence) is 10 percentage points.

**Interpretation of the ODI:**
1. 0%-20%: Minimal disability: This group can cope with most living activities. Usually, no treatment is indicated, apart from advice on lifting, sitting posture, physical fitness, and diet. In this group, some patients have particular difficulty with sitting, and this may be important if their occupation is sedentary (e.g., a typist or truck driver).
2. 20%-40% Moderate disability: This group experiences more pain and problems with sitting, lifting, and standing. Travel and social life are more difficult and they may well be off work. Personal care, sexual activity, and sleeping are not grossly affected, and the back condition can usually be managed by conservative means.
3. 40%-60%: Severe disability: Pain remains the main problem in this group of patients, but travel, personal care, social life, sexual activity, and sleep are also affected. These patients require detailed investigation.
4. 60%-80%: Crippled: Back pain impinges on all aspects of these patients' lives—both at home and at work—and positive intervention is required.
5. 80%-100%: These patients would be bed-bound.

**12-Item Short Form Survey (SF-12)**
This health status survey is commonly used, brief (12 questions), and provides a description of the respondent's health. The SF-12 is a measure of perceived health that describes the degree of general physical health status and mental health distress. The SF-12 is a shorter alternative to the SF-36®. The SF-12 has at least 1 question from each of the SF-36’s original 8 domains. The SF-12 is scored on 2 summary scales, the Physical Component Summary scale and the Mental Component Summary scale, representing the physical and mental factors measured in the survey. Both scales are scored such that the adult population mean is 50, with a standard deviation of 10, and higher scores represent a better function.

**Visual Analog Pain Score (VAS)**
The VAS for pain is a continuous scale which depicts pain intensity along a line (usually 10cm [100 mm] long) that is anchored by 2 verbal descriptors, 1 for each symptom extreme. For pain intensity, the scale is most commonly anchored by "no pain" (score of 0) and "pain as bad as it could be" or "worst imaginable pain" (score of 100) on 100mm scale. Typically, respondents are asked to report current pain intensity or pain intensity in the last 24 hours.
Superion ISS Device vs X-STOP Device (Interspinous)
Patel et al (2015) reported on the results of a multicenter randomized noninferiority trial (10% margin) comparing the Superion ISS with the X-STOP.28 Trial characteristics and results are summarized in Tables 2 and 3. The primary outcome was a composite of a clinically significant improvement in at least one of three ZCQ domain scores compared with baseline; freedom from reoperation, epidural steroid injection, nerve block, rhizotomy, or spinal cord stimulator; and freedom from a major implant or procedure-related complications.

The results at 2 years of follow-up indicated that the primary noninferiority endpoint was met, with a Bayesian posterior probability of 0.993. However, 111 (28%) patients (54 Superion ISS, 57 X-STOP) withdrew from the trial during follow-up because they received a protocol-defined secondary intervention. Modified intention-to-treat analysis showed similar levels of clinical success for leg pain, back pain, and ODI scores. Rates of complications and reoperations were similar between groups. Spinous process fractures, reported as asymptomatic, occurred in 16.4% of Superion ISS patients and 8.5% of X-STOP patients. Subsequently, long-term follow-up results were reported. At 3 years, 120 patients in the Superion ISS group and 129 in the X-STOP group remained (64% [249/391]). Of them, composite clinical success (CCS) was achieved in 52.5% of patients in the Superion ISS group and 38.0% of the X-STOP group (p=0.023). The 36-month clinical outcomes were reported for 82 patients in the Superion ISS group and 76 patients in the X-STOP group (40% [158/391]). It is unclear from the reporting whether the remaining patients were lost to follow-up or were considered treatment failures and censored from the results. Also, trial interpretation is limited by questions about the efficacy of the comparator and lack of a control group treated with surgical decompression. At the 4-year and 5-year follow-ups, only data for the Superion arm were reported, which included data for 90% and 65% of originally randomized patients, respectively. Of these, success on at least 2 of 3 ZCQ domains was observed in 84% of patients at years 4 and 5. Nunley et al (2018) reported a decrease in opioid use (n=107) and improvement in the QOL (n=68) at 5 years, however, results were reported only for patients who had not undergone reoperation or revision, limiting interpretation of these results.29,30

The purpose of the limitations tables (see Tables 4 and 5) is to display notable limitations identified in each study. This information is synthesized as a summary of the body of evidence following each table and provides the conclusions on the sufficiency of the evidence supporting the position statement.

Table 2. Summary of Key RCT Characteristics

<table>
<thead>
<tr>
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<tr>
<td>Patel et al (2015);</td>
<td>U.S.</td>
<td>29</td>
<td>2008-2011</td>
<td>Patients with intermittent neurogenic claudication despite 6 mo of nonsurgical management (N=440)</td>
<td>Superion ISS (n=218) X-STOP spacers (n=222)</td>
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RCT: randomized controlled trial.
Table 3. Results of Noninferiority Trials Comparing Superion With X-STOP

<table>
<thead>
<tr>
<th>Study</th>
<th>Group</th>
<th>n</th>
<th>Success Rates</th>
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<th>VAS Back Pain&lt;sup&gt;a&lt;/sup&gt;</th>
<th>ODI Scores&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Spineal Process Fractures</th>
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<td>Patel et al (2015)&lt;sup&gt;31,28,31&lt;/sup&gt;</td>
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<td>136</td>
<td>75%&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>67%</td>
<td>63%</td>
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<td>X-STOP</td>
<td>144</td>
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<td>68%</td>
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<tr>
<td>Nunley et al (2017)&lt;sup&gt;33&lt;/sup&gt;</td>
<td>Superion</td>
<td>88</td>
<td>84%&lt;sup&gt;d&lt;/sup&gt;</td>
<td>68/85</td>
<td>55/85</td>
<td>57/88</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are n, %, or n (%).
ODI: Oswestry Disability Index; VAS: visual analog scale.
<sup>a</sup>Percentage achieving at least a 20 mm improvement on a 100-mm VAS score.
<sup>b</sup>Percentage achieving at least a 15% improvement in ODI scores.
<sup>c</sup>Composite outcome based on 4 components: improvement in 2 of 3 domains of the Zurich Claudication Questionnaire, no reoperations at the index level, no major implant/procedure-related complications, and no clinically significant confounding treatments.
<sup>d</sup>Clinical success on at least 2 of 3 Zurich Claudication Questionnaire domains.

Table 4. Relevance Limitations

<table>
<thead>
<tr>
<th>Study</th>
<th>Population&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Intervention&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Comparator&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Outcomes&lt;sup&gt;d&lt;/sup&gt;</th>
<th>Follow-Up&lt;sup&gt;e&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patel et al (2015)&lt;sup&gt;28&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The study limitations stated in this table are those notable in the current review; this is not a comprehensive limitations assessment.
<sup>a</sup>Population key: 1. Intended use population unclear; 2. Clinical context is unclear; 3. Study population is unclear; 4. Study population not representative of intended use.
<sup>b</sup>Intervention key: 1. Not clearly defined; 2. Version used unclear; 3. Delivery not similar intensity as comparator; 4. Not the intervention of interest.
<sup>c</sup>Comparator key: 1. Not clearly defined; 2. Not standard or optimal; 3. Delivery not similar intensity as intervention; 4. Not delivered effectively.
<sup>d</sup>Outcomes key: 1. Key health outcomes not addressed; 2. Physiologic measures, not validated surrogates; 3. No CONSORT reporting of harms; 4. Not establish and validated measurements; 5. Clinical significant difference not prespecified; 6. Clinical significant difference not supported.
<sup>e</sup>Follow-Up key: 1. Not sufficient duration for benefit; 2. Not sufficient duration for harms.

Table 5. Study Design and Conduct Limitations

<table>
<thead>
<tr>
<th>Study</th>
<th>Allocation&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Blinding&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Selective Reporting&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Data Completeness&lt;sup&gt;e&lt;/sup&gt;</th>
<th>Power&lt;sup&gt;e&lt;/sup&gt;</th>
<th>Statistical&lt;sup&gt;f&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patel et al (2015)&lt;sup&gt;28&lt;/sup&gt;</td>
<td>3. Allocation concealment unclear</td>
<td>1. Not blinded to treatment assignment</td>
<td>2. Not blinded to treatment assignment</td>
<td>1. High loss to follow-up and/or missing data: 11% of patients not randomized; and data for 28% missing at 2 y; 36% at 3 y.</td>
<td>3. Unclear why a 10% noninferiority margin selected</td>
<td></td>
</tr>
</tbody>
</table>
coflex Device (Interlaminar)

A European, multicenter, randomized, double-blind trial (Foraminal Enlargement Lumbar Interspinous distraction: FELIX) assessed the superiority of coflex (without bony decompression) over bony decompression in 159 patients who had intermittent neurogenic claudication due to LSS. The primary outcome at 8-week and 1-year follow-ups were the ZCQ score. The score increases with increasing disability. Trial characteristics and results are summarized in Tables 6 and 7. At 8 and 52 weeks, the primary outcome efficacy measure in the coflex arm was not superior to that for standard decompression. In addition, more coflex recipients required reoperation than the standard decompression patients at the 1- and 2-year follow-ups. Given the substantially higher frequency of reoperation in the absence of statistically significant improvements in the efficacy outcome, further summarization of study limitations was not done for this trial.

Table 6. Summary of Key RCT Characteristics

<table>
<thead>
<tr>
<th>Study; Trial</th>
<th>Countries</th>
<th>Sites</th>
<th>Dates</th>
<th>Participants</th>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moojen et al (2013)34; FELIX</td>
<td>Netherlands</td>
<td>5</td>
<td>2008-2011</td>
<td>Patients with intermittent neurogenic claudication due to lumbar stenosis with an indication for surgery (N=159)</td>
<td>Coflex (n=80) Decompression (n=79)</td>
</tr>
</tbody>
</table>

RCT: randomized controlled trial.

Table 7. Summary of Key RCT Outcomes

<table>
<thead>
<tr>
<th>Study; Trial</th>
<th>Proportions of Patients Achieving ZCQ Success, a (95% CI), %</th>
<th>Reoperations, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 Weeks</td>
<td>52 Weeks</td>
</tr>
<tr>
<td>Moojen et al (2013; 2014)34,35; FELIX (1-yr follow-up)</td>
<td>142</td>
<td>144</td>
</tr>
<tr>
<td>Coflex</td>
<td>63 (51 to 73)</td>
<td>66 (54 to 74)</td>
</tr>
<tr>
<td>Decompression alone</td>
<td>72 (60 to 81)</td>
<td>69 (57 to 78)</td>
</tr>
<tr>
<td>Odds ratio (p)</td>
<td>0.73 (0.44)</td>
<td>0.90 (0.77)</td>
</tr>
<tr>
<td>Moojen et al (2015)36; FELIX (2-yr follow-up)</td>
<td>145</td>
<td>Not reported</td>
</tr>
<tr>
<td>Coflex</td>
<td>69</td>
<td>23 (33)</td>
</tr>
<tr>
<td>Decompression alone</td>
<td>60</td>
<td>6 (8)</td>
</tr>
<tr>
<td>Odds ratio (p)</td>
<td>0.65 (0.20)</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>

CI: confidence interval; RCT: randomized controlled trial; ZCQ: Zurich Claudication Questionnaire.

a Reductions in ZCQ scores were categorized as successful if at least 2 domain subscales were judged as "success." The ZCQ has 3 domains: symptoms severity, physical function, and patient's satisfaction. Success in the domains was defined as a decrease of at least 0.5 points on the symptom severity scale and on the physical function scale or a score of less than 2.5 on the patient's satisfaction subscale.
Section Summary: Interspinous or Interlaminar Spacer as Stand-Alone Treatment

The evidence for the Superion ISS for LSS includes a pivotal trial. This trial compared the Superion ISS with the X-STOP but did not include comparison groups for conservative treatment or standard surgery. The trial reported significantly better outcomes on some measures. For example, the percentage of patients experiencing improvements in certain QOL outcome domains was reported at over 80%. However, this percentage was based on 40% of the original dataset. Interpretation of this trial is limited by uncertainty about a number of patients used to calculate success rates, the lack of efficacy of the comparator, and the lack of an appropriate control group treated by surgical decompression.

The coflex interlaminar implant was compared with decompression in the multicenter, double-blind FELIX trial. Functional outcomes and pain levels between the 2 groups at 1-year follow-up did not differ statistically but reoperation rates due to lack of recovery were statistically higher with the coflex implant (29%) compared with bony decompression (8%). It is not clear whether patients with reoperations were included in pain and function assessments; if they were, this would have decreased assessment scores at one year. For patients with 2-level surgery, the reoperation rate was 38% for coflex and 6% for bony decompression. At 2 years, reoperations due to the absence of recovery had been performed in 33% of the coflex group compared with 8% of the bony decompression group. This is an off-label use of the device. Use consistent with the FDA label is reviewed in the next section.

Interlaminar Stabilization Devices Used With Spinal Decompression Surgery in Patients With Severe Spinal Stenosis and Grade 1 Spondylolisthesis

Clinical Context and Therapy Purpose

The purpose of placement of an interlaminar spacer in patients with severe spinal stenosis and grade 1 spondylolisthesis is to provide a treatment option that is less invasive than lumbar spinal decompression surgery with fusion and more effective for back pain than lumbar spinal decompression surgery alone. Lumbar spinal stenosis has a broad clinical spectrum. Features that may affect the choice of the surgical procedure include the severity of leg pain, back pain, and instability; the presence of facet hypertrophy, diminished disc height, or deformity; the risk of general anesthesia, and the patient's preferences. The clinical feature that best distinguishes the target population for coflex is the severity of back pain, specifically, back pain that is worse than the leg pain. The hypothesis underlying this use of coflex is that decompression alone, while effective for claudication and other symptoms of spinal stenosis, may be less effective for severe back pain than decompression plus a stabilizing procedure.

The question addressed in this evidence review is: Does the use of an interlaminar spacer in patients with spinal stenosis and no spondylolisthesis or grade 1 spondylolisthesis when used as an adjunct to spinal decompression improve the net health outcome?

The following PICOs were used to select literature to inform this review.

Patients

Individuals with severe spinal stenosis and grade 1 spondylolisthesis who have not responded to conservative treatment.
Interventions
The treatment being considered is the placement of an interlaminar spacer as an adjunct to spinal decompression.

Comparators
The comparators are lumbar spinal decompression with spinal fusion and lumbar spinal decompression surgery without fusion.

Outcomes
The main outcomes of interest are (1) improvements in symptoms of spinal stenosis (eg, claudication, leg pain), (2) reductions in back pain, and (3) reductions in limitations on activities related to symptoms. Symptoms can be measured by scores of validated instruments such as the ODI and the ZCQ as well as VAS for back and leg pain. Other measures such as the 36-Item Short-Form Health Survey to assess the QOL are relevant. Other key outcome measures are reoperations, including fusion procedures, and adverse events. The window to judge treatment success is a minimum of two years postprocedure.

coflex Device Plus Decompression vs Decompression Plus Posterolateral Fusion
The FDA approved coflex on the basis of an open-label, randomized, multicenter, noninferiority trial (-10% noninferiority margin) that compared coflex plus decompression to decompression plus posterolateral fusion in patients who had stenosis, significant back pain, and either no spondylolisthesis or grade 1 spondylolisthesis. The control group was treated with pedicle screw and rod fixation with autograft but without an interbody (intervertebral) cage or bone morphogenetic protein. A total of 398 patients were randomized, of whom 322 were included in the per-protocol analysis. Of 215 coflex patients in the per-protocol analysis, 11 were lost to follow-up at the 2-year endpoint. In the fusion group, 3 of 107 were lost to follow-up. Results of long-term follow-up to five years were reported subsequently.

Trial characteristics and results are summarized in Tables 8 and 9. CCS (a minimum 15-point improvement in ODI score, no reoperations, no device-related complications, no epidural steroid injections in the lumbar spine, and no persistent new or worsening sensory or motor deficit) at 24 months showed that coflex was noninferior to screw and rod fixation (-10% noninferiority margin). Secondary effectiveness criteria, which included ZCQ score, VAS scores for leg and back pain, SF-12 scores, time to recovery, patient satisfaction, and several radiographic endpoints, tended to favor the coflex group. The percentages of device-related adverse events (5.6%) did not differ statistically between the two groups. Wound problems were more frequent in the coflex group (14% vs. 6.5%) but all of these resolved by 3 months. There was a 14% incidence of spinous process fractures in the coflex arm, which were reported to be mostly asymptomatic. The reported follow-up rates through 5 years were at least 85%.

At 2 years, overall success was similar for patients treated with the coflex device at 1 or 2 levels (68.9% and 69.4%, respectively). At 60 months, the CCS was achieved in 48.3% of 1 level and 60.9% of 2 level patients.

A secondary (unplanned) analysis of patients with grade 1 spondylolisthesis (99 coflex patients and 51 fusion patients) showed a decrease in operative time (104 vs 157 minutes; p<0.001) and blood loss (106 vs 336 ml, p <0.001). There were no statistically significant differences between the coflex and fusion groups in ODI, VAS, and ZCQ scores after two years. In that analysis, 59
(62.8%) of 94 coflex patients and 30 (62.5%) of 48 fusion patients met the criteria for operative success. Fusion was obtained in 71% of the control group, leaving nearly a third of patients with pseudoarthrosis. The authors reported no significant differences in ODI or VAS between the patients with pseudoarthrosis or solid fusion, but ZCQ scores were not reported. There were 18 (18%) spinous process fractures in the coflex group, of which 7 had healed by the 2-year follow-up. Reoperation rates were 6% in the fusion group (p=0.18) and 14% in the coflex group, including 8 (8%) coflex cases that required conversion to fusion.

Table 8. Summary of Key RCT Characteristics

<table>
<thead>
<tr>
<th>Study; Trial</th>
<th>Countries</th>
<th>Sites</th>
<th>Dates</th>
<th>Participants</th>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davis et al (2013)38 NCT00534235a</td>
<td>U.S.</td>
<td>21</td>
<td>2006-2008</td>
<td>Patients with spinal stenosis with up to grade 1 spondylolisthesis, 1 or 2 levels with VAS &gt; 50 and ODI &gt; 20 (N=344)</td>
<td>Decompression plus Coflex (n=262)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Decompression plus pedicle screw and rod fixation (n=136)</td>
</tr>
</tbody>
</table>

ODI: Oswestry Disability Index; RCT: randomized controlled trial; VAS: visual analog score

a Noninferiority study.

Table 9. Summary of Key RCT Outcomes

<table>
<thead>
<tr>
<th>Study</th>
<th>CCSa</th>
<th>15-Point Improvement in ODI Score</th>
<th>No Secondary Surgical Intervention or Lumbar Injection</th>
<th>No Secondary Surgical Intervention</th>
<th>No Secondary Lumbar Injection</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-year follow-up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davis et al (2013)38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>308</td>
<td>248</td>
<td>322</td>
<td>215</td>
<td>215</td>
</tr>
<tr>
<td>coflex</td>
<td>135 (66)</td>
<td>139 (86)</td>
<td>173 (81)</td>
<td>192 (89)</td>
<td>190 (88)</td>
</tr>
<tr>
<td>Fusion</td>
<td>104 (58)</td>
<td>66 (77)</td>
<td>89 (83)</td>
<td>99 (93)</td>
<td>94 (88)</td>
</tr>
<tr>
<td>%D (95% CI)</td>
<td>8.5b (-2.9 to 20.0)</td>
<td>9 (NR)</td>
<td>2 (NR)</td>
<td>-4 (NR)</td>
<td>0</td>
</tr>
<tr>
<td>3-year follow-up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bae et al (2016)42</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>290</td>
<td>214</td>
<td>Unclear</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>coflex</td>
<td>(62)</td>
<td>129 (90)</td>
<td>(76)</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Fusion</td>
<td>(49)</td>
<td>53 (76)</td>
<td>(79)</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>%D (95% CI) or p</td>
<td>13.3(1.1 to 25.5)</td>
<td>0.008</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>4-year follow-up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bae et al (2015)43</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>274</td>
<td>181</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>coflex</td>
<td>106 (58)</td>
<td>106 (86)</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Fusion</td>
<td>42 (47)</td>
<td>42 (72)</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>%D (95% CI) or p</td>
<td>10.9(-1.6 to 23.5)</td>
<td>0.038</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>
Studies

Musacchio et al (2016)\textsuperscript{a1}

<table>
<thead>
<tr>
<th>Study; Trial</th>
<th>Population\textsuperscript{a}</th>
<th>Intervention\textsuperscript{b}</th>
<th>Comparator\textsuperscript{c}</th>
<th>Outcomes\textsuperscript{d}</th>
<th>Follow-Up\textsuperscript{e}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davis et al (2013)\textsuperscript{a3}; NCT00534235</td>
<td>4. Study population combines no and grade 1 spondylolisthesis</td>
<td>2. Noninferiority to a comparator whose benefit is uncertain does not permit meaningful interpretation of the net benefit.</td>
<td>1. Outcomes did not include success of the fusion procedure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davis et al (2013)\textsuperscript{a3}; NCT00534235</td>
<td>2. The benefit of the comparator is uncertain. Fusion was not obtained in 29% of cases. Intervertebral cages and BMP were not allowed in the FDA IDE study.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are n or n (%.)

CCS: composite clinical success; CI: confidence interval; FU: follow-up; NR: not reported; ODI: Oswestry Disability Index (reported as mean score or percent with at least 15-point improvement).

\textsuperscript{a} CCS was composed of a minimum 15-point improvement in ODI score, no reoperations, no device-related complications, no epidural steroid injections in the lumbar spine, and no persistent new or worsening sensory or motor deficit.

\textsuperscript{b} The lower bound of Bayesian posterior credible interval for the device group difference in CCS was equal to -2.9%, which is within the prespecified noninferiority margin of -10%.

Tables 10 and 11 display notable limitations identified in each study.

Another limitation in the study, not listed in the limitations tables, is that other published evidence about the use of coflex as an alternative to fusion is sparse. The results of a single randomized trial do not always correspond with the rates of treatment response, complications, and reoperations in actual practice. Although thousands of coflex operations have been performed in the U. S. and elsewhere, there are few data on the performance of coflex plus decompression surgery other than in randomized trials. A retrospective cohort study (NCT03041896) undertaken by the manufacturer has not been reported, and a large registry of studies is not yet complete (NCT02457468).

Table 10. Relevance Limitations

<table>
<thead>
<tr>
<th>Study; Trial</th>
<th>Population\textsuperscript{a}</th>
<th>Intervention\textsuperscript{b}</th>
<th>Comparator\textsuperscript{c}</th>
<th>Outcomes\textsuperscript{d}</th>
<th>Follow-Up\textsuperscript{e}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davis et al (2013)\textsuperscript{a3}; NCT00534235</td>
<td>4. Study population combines no and grade 1 spondylolisthesis</td>
<td>2. Noninferiority to a comparator whose benefit is uncertain does not permit meaningful interpretation of the net benefit.</td>
<td>1. Outcomes did not include success of the fusion procedure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davis et al (2013)\textsuperscript{a3}; NCT00534235</td>
<td>2. The benefit of the comparator is uncertain. Fusion was not obtained in 29% of cases. Intervertebral cages and BMP were not allowed in the FDA IDE study.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BMP: bone morphogenetic protein; IDE: investigational device exemption; FDA: Food and Drug Administration

The study limitations stated in this table are those notable in the current review; this is not a comprehensive limitations assessment.

\textsuperscript{a} Population key: 1. Intended use population unclear; 2. Clinical context is unclear; 3. Study population is unclear; 4. Study population not representative of intended use.

\textsuperscript{b} Intervention key: 1. Not clearly defined; 2. Version used unclear; 3. Delivery not similar intensity as comparator; 4. Not the intervention of interest.

\textsuperscript{c} Comparator key: 1. Not clearly defined; 2. Not standard or optimal; 3. Delivery not similar intensity as intervention; 4. Not delivered effectively.

\textsuperscript{d} Outcomes key: 1. Key health outcomes not addressed; 2. Physiologic measures, not validated surrogates; 3. No CONSORT reporting of harms; 4. Not establish and validated measurements; 5. Clinical significant difference not prespecified; 6. Clinical significant difference not supported.

\textsuperscript{e} Follow-Up key: 1. Not sufficient duration for benefit; 2. Not sufficient duration for harms.
Table 11. Study Design and Conduct Limitations

<table>
<thead>
<tr>
<th>Study; Trial</th>
<th>Allocationa</th>
<th>Blindingb</th>
<th>Selective Reportingc</th>
<th>Data Completenessd</th>
<th>Powere</th>
<th>Statisticalf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davis et al (2013)38; NCT00534235</td>
<td>4. No independent adjudication or preset criteria for subsequent intervention</td>
<td>3. Evidence of selective reporting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davis et al (2013)39; NCT0534235</td>
<td></td>
<td>3. Evidence of selective reporting. ZCQ scores were not reported for the comparison of pseudoarthrosis and solid fusion.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ZCQ: Zurich Claudication Questionnaire.

The study limitations stated in this table are those notable in the current review; this is not a comprehensive limitations assessment.

b Blinding key: 1. Not blinded to treatment assignment; 2. Not blinded outcome assessment; 3. Outcome assessed by treating physician; 4. No independent adjudication or preset criteria for subsequent intervention.
d Data Completeness key: 1. High loss to follow-up or missing data; 2. Inadequate handling of missing data; 3. High number of crossovers; 4. Inadequate handling of crossovers; 5. Inappropriate exclusions; 6. Not intention-to-treat analysis (per protocol for noninferiority trials).
e Power key: 1. Power calculations not reported; 2. Power not calculated for primary outcome; 3. Power not based on clinically important difference.
f Statistical key: 1. Analysis is not appropriate for outcome type: (a) continuous; (b) binary; (c) time to event; 2. Analysis is not appropriate for multiple observations per patient; 3. Confidence intervals and/or p values not reported; 4. Comparative treatment effects not calculated.

Subsection Summary: coflex Device Plus Decompression vs Decompression Plus Posterolateral Fusion

The FDA's approval of coflex was based on an open-label, randomized, noninferiority trial that compared the noninferiority of coflex plus decompression to decompression plus posterolateral fusion in patients who had spinal stenosis, significant back pain, and up to grade 1 spondylolisthesis. Use of the noninferiority framework by the FDA assumed that decompression plus fusion was the standard of care for patients with spinal stenosis with up to grade 1 spondylolisthesis and, because fusion is a more invasive procedure that requires longer operative time and has a potential for higher surgical and postsurgical complications, demonstrating noninferiority with a less invasive procedure such as coflex would be adequate to demonstrate a net benefit in health outcomes. However, subsequent to the approval of coflex, two RCTs the Swedish Spinal Stenosis Study (SSSS), and the Spinal Laminectomy versus
Instrumented Pedicle Screw (SLIP) assessing the superiority of adding fusion to decompression over decompression alone reported a lack of or marginal benefit. The SSSS trial, which was adequately powered to detect a 12-point difference in ODI score, showed no difference in ODI scores between the 2 treatment arms. Hence, the results generated from a noninferiority trial using a comparator whose net benefit on health outcomes is uncertain confound meaningful interpretation of its results. Secondary (posthoc) comparison of the subgroup of patients with grade 1 spondylolisthesis, which may be a more relevant analysis, found similar outcomes between the coflex and fusion groups. However, almost a third of the fusion group had unsuccessful fusion with pseudoarthrosis which raises additional questions about the efficacy of the comparator. ODI and VAS did not significantly differ between the pseudoarthrosis and solid fusion groups, but the ZCQ results were not reported. In addition, posthoc analysis is considered hypothesis-generating. Given the multiple concerns, a prospective trial that compares coflex to fusion in patients with severe spinal stenosis and grade 1 spondylolisthesis is needed.

**Coflex Device Plus Decompression vs Decompression Alone**

Schmidt et al (2018) reported on results of an RCT in patients with moderate-to-severe LSS and back pain with or without spondylolisthesis randomized to open microsurgical decompression with interlaminar stabilization using the coflex device (n=110) or open microsurgical decompression alone (n=115).\(^45\) Trial characteristics and results at 24 months are summarized in Tables 12 and 13. The proportion of patients who met the criteria for CCSat 24 months was statistically and significantly higher in the coflex arm (58.4%) than in the decompression alone arm (41.7%; \(p=0.017\)), with a treatment difference of 16.7% (95% confidence interval, 3.1% to 30.2%). This result was driven primarily by the lower proportion of patients who received an epidural steroid injection in the coflex arm (4.5%) vs the decompression alone arm (14.8%; \(p=0.010\)) at 24 months.

The proportion of patients with ODI success among those censored for subsequent secondary interventions was not statistically significant between the treatment (75.6%) and the control arms (70.4%; \(p=0.47\)). The difference in the proportion of patients overall who had ODI success in the overall sample was also not statistically significant (55% vs 44%, \(p=0.091\)).

None of the other outcomes (data not shown) showed statistically significant differences between the treatment and control arms; outcomes included success measured on the ZCQ (success was defined as an improvement in 2 or 3 ZCQ criteria), success measured on a VAS for pain (success defined as a >20-mm change from baseline), reduction in VAS leg pain, success on a walking distance test (either ≥8-minute walk improvement or the ability to walk to the maximum 15-minute limit), the proportion of patients receiving secondary surgical interventions, or 1- and 2-year survival (Kaplan-Meier) estimates without secondary surgical interventions or survival curves for time to first secondary intervention.

### Table 12. Summary of Key RCT Characteristics

<table>
<thead>
<tr>
<th>Study; Trial</th>
<th>Countries</th>
<th>Sites</th>
<th>Dates</th>
<th>Participants</th>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schmidt et al (2018)(^45); NCT01316211</td>
<td>Germany</td>
<td>7</td>
<td>2008-2014</td>
<td>Patients with moderate-to-severe LSS with or without spondylolisthesis and significant back pain ((N=255))</td>
<td>Decompression with interlaminar stabilization ((n=129))</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open microsurgical decompression alone ((n=131))</td>
</tr>
</tbody>
</table>

LSS: lumbar spinal stenosis; RCT: randomized controlled trial.
Table 13. Summary of Key RCT Outcomes

<table>
<thead>
<tr>
<th>Study</th>
<th>CCSa</th>
<th>15-Point Improvement in ODI Score (all patients)</th>
<th>15-Point Improvement in ODI Score (those not receiving a secondary intervention)</th>
<th>No Secondary Surgical Intervention or Lumbar Injection</th>
<th>No Secondary Surgical Intervention</th>
<th>No Secondary Lumbar Injection</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>204</td>
<td>255</td>
<td>132</td>
<td>225</td>
<td>225</td>
<td>225</td>
</tr>
<tr>
<td>D plus ILS</td>
<td>59 (58)</td>
<td>69 (55)</td>
<td>62 (76)</td>
<td>91 (83)</td>
<td>96 (87)</td>
<td>105 (96)</td>
</tr>
<tr>
<td>D alone</td>
<td>43 (42)</td>
<td>57 (44)</td>
<td>50 (70)</td>
<td>84 (73)</td>
<td>98 (85)</td>
<td>98 (85)</td>
</tr>
<tr>
<td>%D (95% CI)</td>
<td>16.7 (3.1 to 30.2)</td>
<td>10.6 (-1.6 to 22.8)</td>
<td>5.2 (-8.9 to 19.3)</td>
<td>9.7 (-1.1 to 20.4)</td>
<td>2.1 (-6.9 to 11.0)</td>
<td>10.2 (2.7 to 17.8)</td>
</tr>
<tr>
<td>p</td>
<td>0.017</td>
<td>0.091</td>
<td>0.470</td>
<td>0.081</td>
<td>0.655</td>
<td>0.010</td>
</tr>
</tbody>
</table>

Values are n, n (%), or %.

CCS: composite clinical success; CI: confidence interval; D: decompression; ILS: interlaminar stabilization; ODI: Oswestry Disability Index; RCT: randomized controlled trial.

a CCS defined as meeting all 4 criteria: (1) ODI success with improvement >15 points; (2) survivorship with no secondary surgical intervention or lumbar injection; (3) neurologic maintenance or improvement without worsening; and (4) no device- or procedure-related severe adverse events.

The purpose of the limitations tables (see Tables 14 and 15) is to display notable limitations identified in each study. Major limitations are discussed below.

- Based on the reporting by Schmidt et al (2018), 254 patients were randomized but data for only 204 patients were analyzed for the primary outcome measure.45. Thus, data of 20% of patients were excluded. While the proportion of patients excluded was comparable in both arms, the investigators did not explain the missing data of these 50 patients. Lack of a consistent approach in reporting and handling of missing data (patients who remained in the trial but for whom data for repeated longitudinal measures were missing), including describing methods to minimize missing data, reporting reasons for missing data, and using appropriate multiple imputation statistical techniques and sensitivity analysis46, to handle missing data, makes interpretation of trial results challenging.

- The observed treatment effect on the primary composite outcome was primarily driven by a reduction in the use of rescue epidural steroid injection. One concern is a bias that could have been introduced by the open-label design where the treating surgeon also made the assessment that additional intervention with lumbar steroid was needed. The trial design did not include features commonly used to address this problem, such as preset criteria for subsequent intervention, or independent blinded adjudication to verify that subsequent intervention was merited.

- The inclusion of epidural and facet joint injections in the endpoint may be inappropriate for this trial. Epidural injections are less invasive than reoperations, revisions, removal, and supplemental fixations. Nonsurgical therapy, including epidural or facet injections, would be an expected adjunct to decompression alone in patients with predominant back pain. In this context, epidural injections may be offered to provide temporary pain relief that allows a patient to progress with a rehabilitative stretching and exercise program. Censoring patients who undergo particular components of nonsurgical back care may be inappropriate in this context. A better approach would be to measure and report ODI for all patients, or ODI success in all patients except for those who have revisions or reoperations, at 24 months.

- Because of concerns about potential bias, inconsistent reporting of analysis as intention-to-treat, and a lack of critical discussion of the number, timing, pattern, and reason for and
possible implications of missing values, the magnitude of difference might have been overestimated.

Table 14. Relevance Limitations

<table>
<thead>
<tr>
<th>Study</th>
<th>Populationa</th>
<th>Interventionb</th>
<th>Comparatorc</th>
<th>Outcomesd</th>
<th>Follow-Upa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schmidt et al (2018)⁴₅</td>
<td></td>
<td></td>
<td>1. In the control arm, nonsurgical treatment for back pain after decompression should be described</td>
<td>3. No CONSORT reporting of harms</td>
<td>1, 2. Present study reports only on the first 2 y of the 5-y follow-up required by FDA</td>
</tr>
</tbody>
</table>

The study limitations stated in this table are those notable in the current review; this is not a comprehensive limitations assessment. FDA: Food and Drug Administration.

a Population key: 1. Intended use population unclear; 2. Clinical context is unclear; 3. Study population is unclear; 4. Study population not representative of intended use.

b Intervention key: 1. Not clearly defined; 2. Version used unclear; 3. Delivery not similar intensity as comparator; 4. Not the intervention of interest.

c Comparator key: 1. Not clearly defined; 2. Not standard or optimal; 3. Delivery not similar intensity as intervention; 4. Not delivered effectively.

d Outcomes key: 1. Key health outcomes not addressed; 2. Physiologic measures, not validated surrogates; 3. No CONSORT reporting of harms; 4. Not establish and validated measurements; 5. Clinical significant difference not prespecified; 6. Clinical significant difference not supported.

e Follow-Up key: 1. Not sufficient duration for benefit; 2. Not sufficient duration for harms.

Table 15. Study Design and Conduct Limitations

<table>
<thead>
<tr>
<th>Study</th>
<th>Allocationa</th>
<th>Blindingb</th>
<th>Selective Reportingc</th>
<th>Data Completenessd</th>
<th>Powere</th>
<th>Statisticalf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schmidt et al (2018)⁴₅</td>
<td></td>
<td>1. Not blinded to treatment assignment 4. No independent adjudication or preset criteria for subsequent intervention</td>
<td>1. High loss to follow-up or missing data 2. Inadequate handling of missing data. LOCF may not be the most appropriate approach 6. Not intention-to-treat analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The study limitations stated in this table are those notable in the current review; this is not a comprehensive limitations assessment. LOCF: last observation carried forward.


b Blinding key: 1. Not blinded to treatment assignment; 2. Not blinded outcome assessment; 3. Outcome assessed by treating physician. 4. No independent adjudication or preset criteria for subsequent intervention.


d Data Completeness key: 1. High loss to follow-up or missing data; 2. Inadequate handling of missing data; 3. High number of crossovers; 4. Inadequate handling of crossovers; 5. Inappropriate exclusions; 6. Not intention-to-treat analysis (per protocol for noninferiority trials).

e Power key: 1. Power calculations not reported; 2. Power not calculated for primary outcome; 3. Power not based on clinically important difference.

f Statistical key: 1. Analysis is not appropriate for outcome type: (a) continuous; (b) binary; (c) time to event; 2. Analysis is not appropriate for multiple observations per patient; 3. Confidence intervals and/or p values not reported; 4. Comparative treatment effects not calculated.

Nonrandomized Studies

Röder et al (2015) reported on a small cross-registry study that compared lumbar decompression plus coflex (SWISS spine Registry) with lumbar decompression alone (Spine Tango Registry) in 50 pairs matched by a multifactorial propensity score.⁴⁷ The SWISSspine is a governmentally mandated registry from Switzerland for coverage with evidence development. Spine Tango is a voluntary registry from the Spine Society of Europe. Both registries use the numeric rating scale (NRS) for back and leg pain, as well as the Core Outcome Measures Index as the patient-based outcome instrument. The Core Outcome Measures Index consists of seven questions to evaluate
pain, function, well-being, QOL, and disability. At 7- to 9-month follow-up, the coflex group had greater reductions in NRS back pain score (3.8 vs 2.5, p=0.014), NRS leg pain score (4.3 vs 2.5, p<0.001), NRS maximum pain score (4.1 vs 2.3, p=0.002), and greater improvement in Core Outcome Measures Index score (3.7 vs 2.5; p=0.029). Back pain improved by the minimum clinically relevant change in about 60% of patients in the decompression alone group vs 78% in the coflex plus decompression group.

Because of substantial baseline differences between the compared groups, small sample size, and short follow-up time, there is a high-risk that the Röder et al (2015) study’s estimate of the effect of decompression alone vs decompression plus coflex is biased. Decompression alone had better outcomes than those reported by Röder et al (2015) in a larger, well-conducted, 12-month European registry study of patients with spinal stenosis, significant back, and no spondylolisthesis. Richter et al (2010) reported on a prospective case-control study of the coflex device in 60 patients who underwent decompression surgery. Richter et al (2014) also published a 2-year follow-up. The surgeon determined whether the midline structures were preserved or resected and whether the coflex device was implanted (one or two levels). The indications for the two groups were identical and the use of the device was considered incidental to the surgery. At 1- and 2-year follow-ups, placement of a coflex device did not significantly improve the clinical outcome compared with decompression surgery alone.

Some radiologic findings with the coflex device require additional study to determine their clinical significance. Tian et al (2013) reported a high rate (81.2%) of heterotopic ossification at follow-up (range, 24-57 months) in patients who had received a coflex device. In 16 (50%) of 32 patients, heterotopic ossification was detected in the interspinous space but had not bridged the space, while in 2 (6.3%) patients there was interspinous fusion. In the nine patients followed for more than three years, class II (interspinous space but not bridging) and class III (bridging) heterotopic ossification was detected in all nine. Lee et al (2016) reported erosion around the spinous process and reductions in disc height and range of motion in patients treated with a coflex device plus spinal decompression and had at least 24 months of follow-up. Erosion around the coflex device, which was observed in 47% of patients, has the potential to result in spinous process fracture or device malposition. Continued follow-up is needed.

**Subsection Summary: coflex Device Plus Decompression vs Decompression Alone**

One RCT, conducted in a patient population who had moderate-to-severe LSS with or without spondylolisthesis, showed that a greater proportion of patients who received coflex plus decompression achieved the primary endpoint of CCS compared with decompression alone. This composite endpoint was primarily driven by a greater proportion of patients who received a secondary rescue epidural steroid injection in the control arm while there was no difference in the proportion of patients who achieved a meaningful reduction of 15 points in ODI score in the treatment and the control arms. However, the decision to use rescue epidural steroid injection introduced possible bias given that the trial was open-label. No attempts were made to mitigate this potential bias using protocol-mandated standard objective clinical criteria to guide decisions about the use of secondary interventions and subsequent adjudication of these events by an independent blinded committee. Given these critical shortcomings, trial results might have been biased. Greater certainty about the net health outcome of adding coflex to decompression surgery might be demonstrated when results of 5-year follow-up of this trial and
an ongoing RCT (NCT02555280) on decompression with and without the coflex implant in the U. S. are published. Consideration of existing studies as indirect evidence regarding the outcomes of using spacers in this subgroup is limited by substantial uncertainty regarding the balance of potential benefits and harms. Limitations of the published evidence preclude determining the effects of the technology on net health outcome. Evidence reported through clinical input offered varying degrees of support but was not predominantly supportive of a clinically meaningful improvement in net health outcome for this population. While some of the expert opinions supported a potential benefit in carefully selected individuals, other experts were not confident of a clinically meaningful benefit or use in generally accepted medical practice, citing long-term complications leading to the removal of the device. Further details from clinical input included in the Clinical Input section later in the review and the Appendix.

Interlaminar Stabilization Devices Used With Spinal Decompression Surgery in Patients With No Spondylolisthesis or Instability

Clinical Context and Therapy Purpose

The purpose of placement of an interlaminar spacer in patients with spinal stenosis and no spondylolisthesis or spinal instability is to provide a treatment option that is less invasive than lumbar spinal decompression surgery with fusion and more effective for back pain than lumbar spinal decompression surgery alone. LLS has a broad clinical spectrum. Features that may affect the choice of the surgical procedure include the severity of leg pain, back pain, and instability; the presence of facet hypertrophy, diminished disc height, or deformity; the risk of general anesthesia, and the patient's preferences. The clinical feature that best distinguishes the target population for coflex is the severity of back pain, specifically, back pain that is worse than the leg pain. The hypothesis underlying this use of coflex is that decompression alone, while effective for claudication and other symptoms of spinal stenosis, may be less effective for severe back pain than decompression plus a stabilizing procedure.

The question addressed in this evidence review is: Does the use of an interlaminar spacer in patients with spinal stenosis and no spondylolisthesis or grade 1 spondylolisthesis when used as an adjunct to spinal decompression improve the net health outcome?

The following PICOs were used to select literature to inform this review.

Patients
Individuals with spinal stenosis and no spondylolisthesis or instability who have not responded to conservative treatment.

Interventions
The treatment being considered is the placement of an interlaminar spacer as an adjunct to spinal decompression.

Comparators
The comparators are lumbar spinal decompression alone.

Outcomes
The main outcomes of interest are (1) improvements in symptoms of spinal stenosis (eg, claudication, leg pain), (2) reductions in back pain, and (3) reductions in limitations on activities related to symptoms. Symptoms can be measured by scores of validated instruments such as the
ODI and the ZCQ as well as VAS for back and leg pain. Other measures such as the 36-Item Short-Form Health Survey to assess the QOL are relevant. Other key outcome measures are reoperations, including fusion procedures, and adverse events. The window to judge treatment success is a minimum of two years postprocedure.

**coflex Device Plus Decompression vs Decompression Plus Posterolateral Fusion**

Abjornson et al (2018) reported outcomes from the subgroup of patients without spondylolisthesis who received an interlaminar device with decompression in the pivotal investigational device exemption trial, but comparison with decompression alone in this population has not been reported. The major weakness in this trial was its use of lumbar spinal fusion as a comparator for patients with no spondylolisthesis. The underlying premise that patients with back pain and spinal stenosis do not respond well to decompression (alone or followed by nonsurgical treatments for back pain) has been challenged. For example, the ODI success rate for decompression alone in the European Study of Coflex And Decompression Alone trial was comparable to the ODI success rate for decompression plus fusion in the pivotal trial.

**Section Summary: Interlaminar Stabilization Devices Used With Spinal Decompression Surgery in Patients With No Spondylolisthesis or Instability**

The pivotal RCT, conducted in a patient population with spondylolisthesis no greater than grade 1 and significant back pain, showed that stabilization of decompression with the coflex implant was noninferior to decompression with spinal fusion for the CCS measure. However, there is uncertainty about the net benefit of routinely adding spinal fusion to decompression in patients without spondylolisthesis. Fusion after open decompression laminectomy is a more invasive procedure that requires longer operative time and has a potential for higher procedural and postsurgical complications. When the trial was conceived, decompression plus fusion was viewed as the standard of care for patients with spinal stenosis with up to grade 1 spondylolisthesis and back pain; thus demonstrating noninferiority with a less invasive procedure such as coflex would be adequate to result in a net benefit in health outcomes. However, the role of fusion in the population of patients represented in the pivotal trial is uncertain, especially since the publication of the SSSS and the SLIP, 2 RCTs comparing decompression alone with decompression plus spinal fusion that was published in 2016. As a consequence, results generated from a noninferiority trial using a comparator whose net benefit on health outcome is uncertain confounds meaningful interpretation of trial results. Therefore, demonstrating the noninferiority of coflex plus spinal decompression vs spinal decompression plus fusion, a comparator whose benefit on health outcomes is uncertain, makes it difficult to apply the results of the study. Outcomes from the subgroup of patients without spondylolisthesis who received an interlaminar device with decompression in the pivotal investigational device exemption trial have been published, but comparison with decompression alone in this population has not been reported. Limitations of the published evidence preclude determining the effects of the technology on net health outcome. Evidence reported through clinical input offered varying degrees of support but was not predominantly supportive of a clinically meaningful in net health outcome, with respondents noting an increase in complications and need for additional surgery compared to laminectomy alone.

**Summary of Evidence**

The following conclusions are based on a review of the evidence, including, but not limited to, published evidence and clinical expert opinion, via BCBSA’s Clinical Input Process.
For individuals who have spinal stenosis and no spondylolisthesis or grade 1 spondylolisthesis who receive an interspinous or interlaminar spacer as a stand-alone procedure, the evidence includes two RCTs of two spacers (Superion Indirect Decompression System, coflex interlaminar implant). The relevant outcomes are symptoms, functional outcomes, QOL, and treatment-related morbidity. Overall, the use of interspinous or interlaminar distraction devices (spacers) as an alternative to spinal decompression has shown high failure and complication rates. A pivotal trial compared the Superion ISS with the X-STOP (which is no longer marketed), without conservative care or standard surgery comparators. The trial reported significantly better outcomes with the Superion ISS on some measures. For example, the trial reported more than 80% of patients experienced improvements in certain QOL outcome domains. Interpretation of this trial is limited by questions about the number of patients used to calculate success rates, the lack of efficacy of the comparator, and the lack of an appropriate control group treated by surgical decompression. The coflex interlaminar implant (formerly called the interspinous U) was compared with decompression in the multicenter, double-blind FELIX trial. Functional outcomes and pain levels were similar in the 2 groups at 1-year follow-up, but reoperation rates due to the absence of recovery were substantially higher with the coflex implant (29%) than with bony decompression (8%). For patients with 2-level surgery, the reoperation rate was 38% for coflex and 6% for bony decompression. At 2 years, reoperations due to the absence of recovery had been performed in 33% of the coflex group and 8% of the bony decompression group. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have severe spinal stenosis and grade 1 spondylolisthesis who have failed conservative therapy who receive an interlaminar spacer with spinal decompression surgery, the evidence includes two RCTs with a mixed population of patients. The relevant outcomes are symptoms, functional outcomes, QOL, and treatment-related morbidity. Use of the coflex interlaminar implant as a stabilizer after surgical decompression has been studied in two situations as an adjunct to decompression compared with decompression alone (superiority) and as an alternative to spinal fusion after decompression (noninferiority). For decompression with coflex vs decompression with lumbar spinal fusion, the pivotal RCT, conducted in a patient population with spondylolisthesis no greater than grade 1 and significant back pain, showed that stabilization of decompression with the coflex implant was noninferior to decompression with spinal fusion for the CCS measure. A secondary (unplanned) analysis of patients with grade 1 spondylolisthesis (99 coflex patients and 51 fusion patients) showed a decrease in operative time (104 vs 157 minutes; \( p<0.001 \)) and blood loss (106 vs 336 ml, \( p<0.001 \)). There were no statistically significant differences between the coflex and fusion groups in ODI, VAS, and ZCQ scores after two years. In that analysis, 62.8% of coflex patients and 62.5% of fusion patients met the criteria for operative success. The efficacy of the comparator in this trial is uncertain because successful fusion was obtained in only 71% of the control group, leaving nearly a third of patients with pseudoarthrosis. The report indicated no significant differences in ODI or VAS between the patients with pseudoarthrosis or solid fusion, but ZCQ scores were not reported. There were 18 (18%) spinous process fractures in the coflex group, of which 7 had healed by the 2-year follow-up. Reoperation rates were 6% in the fusion group and 14% in the coflex group (\( p=0.18 \)), including 8 (8%) coflex cases that required conversion to fusion. This secondary analysis is considered hypothesis-generating, and a prospective trial in patients with grade 1 spondylolisthesis is needed. In a RCT conducted in a patient population with moderate-to-severe LSS with significant back pain and up to grade 1 spondylolisthesis, there was no difference in the primary outcome measure, the ODI, between the patients treated with coflex plus decompression vs. decompression alone. CCS, defined as a
minimum 15-point improvement in ODI score, no reoperations, no device-related complications, no epidural steroid injections in the lumbar spine, and no persistent new or worsening sensory or motor deficit, was used to assess superiority. A greater proportion of patients who received coflex plus decompression instead of decompression alone achieved the composite endpoint. However, the superiority of coflex plus decompression is uncertain because the difference in the CCS was primarily driven by a greater proportion of patients in the control arm who received a secondary rescue epidural steroid injection. Because the trial was open-label, surgeons' decision to use epidural steroid injection could have been affected by their knowledge of the patient's treatment. Consequently, including this component in the CCS measure might have overestimated the potential benefit of treatment. Analysis was not reported separately for the group of patients who had grade 1 spondylolisthesis, leaving the question open about whether the implant would improve outcomes in this population. Limitations of the published evidence preclude determining the effects of the technology on net health outcome, and evidence reported through clinical input is not universally supportive of a clinically meaningful improvement in net health outcome. While some respondents considered the shorter recovery time and lower complication rate to be an advantage compared to fusion, others noted an increase in complications and the need for additional surgery with the device. Consideration of existing studies as indirect evidence regarding the outcomes of using spacers in this subgroup is limited by substantial uncertainty regarding the balance of potential benefits and harms. The evidence is insufficient to determine the effect of the technology on health outcomes.

For individuals who have spinal stenosis and no spondylolisthesis who receive an interlaminar spacer with spinal decompression surgery, the evidence includes an RCT. The relevant outcomes are symptoms, functional outcomes, QOL, and treatment-related morbidity. The pivotal RCT, conducted in a patient population with spondylolisthesis no greater than grade 1 and significant back pain, showed that stabilization of decompression with the coflex implant was noninferior to decompression with spinal fusion for the CCS measure. However, in addition to concerns about the efficacy of fusion in this study, there is uncertainty about the net benefit of routinely adding spinal fusion to decompression in patients with no spondylolisthesis. Fusion after open decompression laminectomy is a more invasive procedure that requires longer operative time and has a potential for higher procedural and postsurgical complications. When the trial was conceived, decompression plus fusion was viewed as the standard of care for patients with spinal stenosis with up to grade 1 spondylolisthesis and back pain; thus demonstrating noninferiority with a less invasive procedure such as coflex would be adequate to result in a net benefit in health outcomes. However, the role of fusion in the population of patients represented in the pivotal trial is uncertain, especially since the publication of the SSSS and the SLIP, 2 RCTs comparing decompression alone with decompression plus spinal fusion that were published in 2016. As a consequence, results generated from a noninferiority trial using a comparator whose net benefit on health outcome is uncertain confounds meaningful interpretation of trial results. Therefore, demonstrating the noninferiority of coflex plus spinal decompression vs spinal decompression plus fusion, a comparator whose benefit on health outcomes is uncertain, makes it difficult to apply the results of the study. Outcomes from the subgroup of patients without spondylolisthesis who received an interlaminar device with decompression in the pivotal IDE trial have been published, but comparison with decompression alone in this population has not been reported. Limitations of the published evidence preclude determining the effects of the technology on net health outcome. Evidence reported through clinical input is not generally supportive of a clinically meaningful improvement in net health outcome, with clinical experts noting an increase in complications and
need for additional surgery compared to laminectomy alone. The evidence is insufficient to
determine the effects of the technology on health outcomes.

**Clinical Input From Physician Specialty Societies and Academic Medical Centers**
While the various physician specialty societies and academic medical centers may collaborate
with and make recommendations during this process, through the provision of appropriate
reviewers, input received does not represent an endorsement or position statement by the
physician specialty societies or academic medical centers, unless otherwise noted.

**2018 Input**
In response to requests, clinical input on the use of interlaminar spacer with spine decompression
in individuals with spinal stenosis, predominant back pain, and no or grade 1 spondylolisthesis
who failed conservative treatment was received from 6 respondents, including 2 specialty society-
level responses and 4 physician-level responses, including 2 identified through a specialty society
and 2 through an academic medical center, while this policy was under review in 2018. Evidence
from clinical input is integrated within the Rationale section summaries and the Summary of
Evidence.

**2011 Input**
In response to requests, input was received from 2 physician specialty societies and 2 academic
medical centers while this policy was under review in 2011. Two of those providing input agreed
this technology is investigational due to the limited high-quality data on long-term outcomes
(including durability). Two reviewers did not consider this technology investigational, stating that
it has a role in the treatment of selected patients with neurogenic intermittent claudication.

**2009 Input**
In response to requests, input was received from 1 physician specialty society and 3 academic
medical centers while this policy was under review in 2009. Differing input was received; several
reviewers indicated data were sufficient to demonstrate improved outcomes.

**Practice Guidelines and Position Statements**
**International Society for the Advancement of Spine Surgery**
The International Society for the Advancement of Spine Surgery (2016) published
recommendations and coverage criteria for decompression with interlaminar stabilization. The
Society concluded that an interlaminar spacer in combination with decompression can provide
stabilization in patients who do not present with greater than grade 1 instability. Criteria
included:
1. Radiographic confirmation of at least moderate lumbar stenosis
2. Radiographic confirmation of the absence of gross angular or translatory instability of the
   spine at index or adjacent levels
3. Patients who experience relief in flexion from their symptoms of leg/buttocks/groin pain, with
   or without back pain, and who have undergone at least 12 weeks of non-operative treatment.

The document did not address interspinous and interlaminar distraction devices without
decompression.
North American Spine Society
The NASS(2018) published specific coverage policy recommendations on the lumbar interspinous device without fusion and with decompression.54 The NASS recommended that:
"Stabilization with an interspinous device without fusion in conjunction with laminectomy may be indicated as an alternative to lumbar fusion for degenerative lumbar stenosis with or without low-grade spondylolisthesis (less than or equal to 3 mm of anterolisthesis on a lateral radiograph) with qualifying criteria when appropriate:
1. Significant mechanical back pain is present (in addition to those symptoms associated with neural compression) that is felt unlikely to improve with decompression alone. Documentation should indicate that this type of back pain is present at rest and/or with movement while standing and does not have characteristics consistent with neurogenic claudication.
2. A lumbar fusion is indicated post-decompression for a diagnosis of lumbar stenosis with a Grade 1 degenerative spondylolisthesis as recommended in the NASS Coverage Recommendations for Lumbar Fusion.
3. A lumbar laminectomy is indicated as recommended in the NASS Coverage Recommendations for Lumbar Laminectomy.
4. Previous lumbar fusion has not been performed at an adjacent segment.
5. Previous decompression has been performed at the intended operative segment.

Interspinous devices are NOT indicated in cases that do not fall within the above parameters. In particular, they are not indicated in the following scenarios and conditions:
1. Degenerative spondylolisthesis of Grade 2 or higher.
2. Degenerative scoliosis or other signs of coronal instability.
3. Dynamic instability as detected on flexion-extension views demonstrating at least 3 mm of change in translation.
4. Iatrogenic instability or destabilization of the motion segment.
5. A fusion is otherwise not indicated for a Grade 1 degenerative spondylolisthesis and stenosis as per the NASS Coverage Recommendations for Lumbar Fusion.
6. A laminectomy for spinal stenosis is otherwise not indicated as per the NASS Coverage Recommendations for Lumbar Laminectomy."

American Pain Society
The guidelines from the American Pain Society (2009) indicated that interspinous spacer devices, based on fair evidence, have a B recommendation (clinicians should consider offering the intervention).55,56 The net benefit was considered moderate through two years, with insufficient evidence to estimate the net benefit for long-term outcomes.

National Institute for Health and Care Excellence
The National Institute for Health and Care Excellence (2010) published guidance that indicated "Current evidence on interspinous distraction procedures for lumbar spinal stenosis causing neurogenic claudication shows that these procedures are efficacious for carefully selected patients in the short and medium-term, although failure may occur and further surgery may be needed."57 The evidence reviewed consisted mainly of reports on X-STOP.

U.S. Preventive Services Task Force Recommendations
Not applicable.
Ongoing and Unpublished Clinical Trials
Some currently ongoing and unpublished trials that might influence this review are listed in Table 16.

Table 16. Summary of Key Trials

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCT02555280a</td>
<td>A 2 and 5 Year Comparative Evaluation of Clinical Outcomes in the Treatment of Degenerative Spinal Stenosis With Concomitant Low Back Pain by Decompression With and Without Additional Stabilization Using the Coflex® Interlaminar Technology for FDA Real Conditions of Use Study (Post-Approval 'Real Conditions of Use' Study)</td>
<td>345</td>
<td>Jun 2022</td>
</tr>
<tr>
<td>NCT02457468a</td>
<td>The Coflex® COMMUNITY Study: An Observational Study of Coflex® Interlaminar Technology</td>
<td>500</td>
<td>Jun 2023</td>
</tr>
<tr>
<td>Unpublished</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCT03041896a</td>
<td>Retrospective Evaluation of the Clinical and Radiographic Performance of Coflex® Interlaminar Technology Versus Decompression With or Without Fusion</td>
<td>5000</td>
<td>Aug 2018 (completed)</td>
</tr>
</tbody>
</table>

NCT: national clinical trial.
a Denotes industry-sponsored or cosponsored trial.

CODING
The following codes for treatment and procedures applicable to this policy are included below for informational purposes. Inclusion or exclusion of a procedure, diagnosis or device code(s) does not constitute or imply member coverage or provider reimbursement. Please refer to the member’s contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

CPT/HCPCS

22867 Insertion of interlaminar/interspinous process stabilization/distraction device, without fusion, including image guidance when performed, with open decompression, lumbar; single level
22868 Insertion of interlaminar/interspinous process stabilization/distraction device, without fusion, including image guidance when performed, with open decompression, lumbar; second level (List separately in addition to code for primary procedure)
22869 Insertion of interlaminar/interspinous process stabilization/distraction device, without open decompression or fusion, including image guidance when performed, lumbar; single level
22870 Insertion of interlaminar/interspinous process stabilization/distraction device, without open decompression or fusion, including image guidance when performed, lumbar; second level (List separately in addition to code for primary procedure)
C1821 Interspinous process distraction device (implantable)

DIAGNOSES
Experimental / Investigational for all diagnoses related to this medical policy.
## REVISIONS

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>02-08-2010</td>
<td>The Interspinous Distraction Devices (Spacers) medical policy is a new freestanding policy developed from the Minimally Invasive Procedures for Spine Pain medical policy which was effective October 18, 2004. The Minimally Invasive Procedures for Spine Pain is no longer an active medical policy.</td>
</tr>
<tr>
<td>06-27-2011</td>
<td>Description updated. Rationale updated. In Coding section: • Removed CPT code 22899 as there are specific codes for this service. References updated.</td>
</tr>
<tr>
<td>02-24-2012</td>
<td>Description updated. Rationale updated. References updated.</td>
</tr>
<tr>
<td>03-19-2013</td>
<td>Description updated. Rationale updated. References updated.</td>
</tr>
<tr>
<td>01-23-2015</td>
<td>Updated Title to &quot;Interspinous and Interlaminar Stabilization / Distraction Devices (Spacers)&quot; from &quot;Interspinous Distraction Devices (Spacers)&quot; Description updated In Policy section: • Added new experimental / investigational indication of &quot;Use of an interlaminar stabilization device following decompressive surgery is considered experimental / investigational.&quot; Rationale updated In Coding section: • Added CPT Code: 22899 (for interlaminar stabilization) References updated</td>
</tr>
<tr>
<td>07-21-2015</td>
<td>Updated Description section. Updated Rationale section. Updated References section.</td>
</tr>
<tr>
<td>06-08-2016</td>
<td>Updated Description section. Updated Rationale section. Updated References section.</td>
</tr>
<tr>
<td>06-09-2017</td>
<td>Updated Description section. In Policy section: • In Item A, added &quot;or interlaminar&quot;, &quot;as a stand-alone procedure&quot;, and &quot;spinal stenosis&quot; and removed &quot;neurogenic intermittent claudication&quot; to read, &quot;Interspinous or interlaminar distraction devices as a stand-alone procedure are considered experimental / investigational as a treatment of spinal stenosis.&quot; • In Item B, changed &quot;decompressive&quot; to &quot;decompression&quot; to read, &quot;Use of an interlaminar stabilization device following decompression surgery is considered experimental / investigational.&quot; Updated Rationale section. In Coding section: • Added coding bullet. Updated References section.</td>
</tr>
<tr>
<td>02-01-2019</td>
<td>Updated Description section. Updated Rationale section. In Coding section:</td>
</tr>
</tbody>
</table>
REVISIONS

- Removed CPT code: 22899.
- Removed coding bullets.

Updated References section.

06-05-2019
Updated Description section.
Updated Rationale section.
Updated References section.

05-18-2020
Updated Description section.
Updated Rationale section.
Updated References section.

REFERENCES


