Bone Morphogenetic Protein

Policy Number: 7.01.100  Last Review: 12/2017

Policy
Blue Cross and Blue Shield of Kansas City (Blue KC) will provide coverage for bone morphogenetic protein when it is determined to be medically necessary because the criteria shown below are met.

When Policy Topic is covered
Use of recombinant human bone morphogenetic protein-2 (rhBMP-2, InFUSE) may be considered medically necessary in skeletally mature patients:

- For anterior lumbar interbody fusion procedures when use of autograft is infeasible.
- For instrumented posterolateral intertransverse spinal fusion procedures when use of autograft is infeasible.
- For the treatment of acute, open fracture of the tibial shaft when use of an autograft is unfeasible.

When Policy Topic is not covered
Use of recombinant human bone morphogenetic protein (rhBMP-2) is considered not medically necessary for all other indications, including but not limited to spinal fusion when use of autograft is feasible and craniomaxillofacial surgery.

Considerations
Use of iliac crest bone graft (ICBG) may be considered infeasible due to situations that may include, but are not limited to, prior harvesting of ICBG or need for a greater quantity of ICBG than available (eg, for multilevel fusion).

There is no specific CPT or HCPCS code for bone morphogenetic protein (BMP). In 2011, CPT code 20930 was revised to include BMP-type materials used in spine surgery:

20930: Allograft, morselized, or placement of osteopromotive material, for spine surgery only (List separately in addition to code for primary procedure).

For spinal fusion, bone morphogenetic proteins may be used primarily as an alternative to autologous bone grafting. Because harvesting of autologous bone
graft is coded separately from the fusion procedure (ie, CPT codes 20936-20938), when bone morphogenetic protein is used as an alternative to the bone graft, these codes should no longer be reported. In contrast, the CPT code for treating tibial fracture nonunions with autograft (ie, CPT code 27724) includes the harvesting component and, therefore, when bone morphogenetic protein is used as an alternative in this setting, presumably the associated physician’s work would be decreased, because no autologous harvest is required. Finally, for treatment of acute, open tibial fractures, BMP is not used as an alternative to autologous bone graft, but in addition to standard treatment with an intramedullary nail.

ICD10-PCS procedure codes 3E0U0GB, 3E0U3GB, 3E0V0GB, and 3E0V3GB explicitly identify the use of BMP in open or percutaneous procedures on joints and bones.

Description of Procedure or Service

<table>
<thead>
<tr>
<th>Populations</th>
<th>Interventions</th>
<th>Comparators</th>
<th>Outcomes</th>
</tr>
</thead>
</table>
| Individuals:  
  ▪ Who are undergoing anterior or posterolateral lumbar spinal fusion and in whom autograft is infeasible | Interventions of interest are:  
  ▪ Recombinant human bone morphogenetic protein | Comparators of interest are:  
  ▪ Allograft bone or synthetic bone substitute | Relevant outcomes include:  
  ▪ Symptoms  
  ▪ Morbid events  
  ▪ Functional outcomes  
  ▪ Treatment-related morbidity |
| Individuals:  
  ▪ Who are undergoing surgery for acute tibial shaft fracture and in whom autograft is infeasible | Interventions of interest are:  
  ▪ Recombinant human bone morphogenetic protein | Comparators of interest are:  
  ▪ Plate or intramedullary nail | Relevant outcomes include:  
  ▪ Symptoms  
  ▪ Morbid events  
  ▪ Functional outcomes  
  ▪ Treatment-related morbidity |
| Individuals:  
  ▪ Who are undergoing other surgical procedures (eg, oral and maxillofacial, hip arthroplasty, distraction osteogenesis) | Interventions of interest are:  
  ▪ Recombinant human bone morphogenetic protein | Comparators of interest are:  
  ▪ Autograft plus allograft bone | Relevant outcomes include:  
  ▪ Symptoms  
  ▪ Morbid events  
  ▪ Functional outcomes  
  ▪ Treatment-related morbidity |

Two recombinant human bone morphogenetic proteins (rhBMPs) are now commercially available, rhBMP-2, applied with an absorbable collagen sponge (InFUSE, Medtronic, Memphis, TN) and rhBMP-7, applied in putty (OP-1). These products have been investigated as an alternative to bone autografting in a variety of clinical situations, including spinal fusions, internal fixation of fractures, treatment of bone defects, and reconstruction of maxillofacial conditions.

The evidence for rhBMP in individuals who are undergoing anterior or posterolateral lumbar spinal fusion and in whom autograft is not feasible includes randomized controlled trials (RCTs) and systematic reviews of RCTs. Relevant
outcomes are symptoms, morbid events, functional outcomes, and treatment-related morbidity. In 2013, 2 systematic reviews of rhBMP-2 trials that used manufacturer-provided individual patient data were published. Overall, these systematic reviews found little to no benefit of rhBMP-2 over iliac crest bone graft for all patients undergoing spinal fusion, with an uncertain risk of harm. The small benefits reported do not support the widespread use of rhBMP-2 as an alternative to iliac crest autograft. However, the studies do establish that rhBMP-2 has efficacy in promoting bone fusion and will improve outcomes for patients for whom use of iliac crest bone graft is not feasible. The overall rate of adverse events was a low, though concerns remain about increased adverse event rates with rhBMP-2, including cancer. The evidence is sufficient to determine qualitatively that the technology results in a meaningful improvement in the net health outcome.

For individuals who are undergoing surgery for acute tibial shaft fracture and in whom autograft is infeasible who receive rhBMP, the evidence includes RCTs and systematic reviews of the RCTs. Relevant outcomes are symptoms, morbid events, functional outcomes, and treatment-related morbidity. Two systematic reviews have concluded that rhBMP can reduce reoperations rates compared with soft-tissue management with or without intramedullary nailing. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals undergoing other surgical procedures (eg, oral and maxillofacial, hip arthroplasty, distraction osteogenesis) who receive rhBMP, the evidence includes a health technology assessment and small case series. Relevant outcomes are symptoms, morbid events, functional outcomes, and treatment-related morbidity. The evidence does not permit conclusions about the effect of rhBMP for craniomaxillofacial surgery or tibial shaft fracture nonunion. The evidence is insufficient to determine the effects of the technology on health outcomes.

Background
Bone morphogenetic proteins (BMPs) are members of the family of transforming growth factors. At present, some 20 different BMPs have been identified, all with varying degrees of cartilage and/or bone inductive properties. RhBMPs are delivered to the bone grafting site as part of a surgical procedure; a variety of carrier and delivery systems has been investigated. Carrier systems, which are absorbed over time, function to maintain the concentration of the rhBMP at the treatment site; provide temporary scaffolding for osteogenesis; and prevent extraneous bone formation. Carrier systems have included inorganic material, synthetic polymer, natural polymers, and bone allograft. The rhBMP and carrier may be inserted via a delivery system, which may also function to provide mechanical support.

The carrier and delivery system are important variables in the clinical use of rhBMPs, and different clinical applications, such as long-bone nonunion, or interbody or intertransverse fusion, have been evaluated with different carriers and delivery systems. For example, rhBMP putty with pedicle and screw devices are used for instrumented intertransverse fusion (posterolateral fusion; PLF), while
rhBMP in a collagen sponge with bone dowels or interbody cages are used for interbody spinal fusion. In addition, interbody fusion of the lumbar spine can be approached from an anterior (anterior lumbar interbody fusion; ALIF), lateral (XLIF), or posterior direction (PLIF or TLIF). Surgical procedures may include decompression of the spinal canal and insertion of pedicle screws and rods to increase stability of the spine.

Posterior approaches (PLIF and TLIF) allow decompression (via laminotomies and facetectomies) for treatment of spinal canal pathology (eg, spinal stenosis, lateral recess and foraminal stenosis, synovial cysts, hypertrophic ligamentum flavum) along with stabilization of the spine and are differentiated from instrumented or noninstrumented posterolateral intertransverse fusion (PLF), which involves the transverse processes. Due to the proximity of these procedures to the spinal canal, risks associated with ectopic bone formation are increased (eg, radiculopathies). Increased risk of bone resorption around rhBMP grafts, heterotopic bone formation, epidural cyst formation, and seromas has also been postulated.

**Regulatory Status**

At present, 2 rhBMPs and associated carrier and delivery systems have been approved by the U.S. Food and Drug Administration (FDA). The Infuse® system (Medtronic, Minneapolis, MN), which consists of rhBMP-2 on an absorbable collagen sponge carrier, was approved through the premarket approval process (P00054). OP-1® Putty (Stryker Biotech, Hopkinton, MA), which consists of rhBMP-7 and bovine collagen and is reconstituted with saline to form a paste, was approved through a humanitarian device exemption process (H020008). The addition of carboxymethylcellulose forms putty.

Infuse® Bone Graft utilizes the approved rhBMP-2 product in conjunction with 1 of 2 interbody fusion devices (ie, either the LT-Cage™ Lumbar Tapered Fusion Device or the Inter Fix™ RP Threaded Fusion device) was approved by FDA through the premarket approval process (P00058). The device is indicated for spinal fusion procedures in skeletally mature patients with degenerative disc disease at 1 level from L2 to S1. Degenerative disc disease is defined as discogenic back pain with degeneration of the disc confirmed by patient history, function deficit, and/or neurologic deficit and radiographic studies. These degenerative disc disease patients may also have up to grade I spondylolisthesis at the involved level or retrolisthesis. The Infuse® Bone Graft/LT-CAGE™ devices are to be implanted via an anterior open or a laparoscopic approach, while the Infuse® Bone Graft/INTER FIX™ Threaded Fusion Device and Infuse® Bone Graft/INTER FIX™ RP Threaded Fusion Device are to be implanted via an anterior open approach only. Patients receiving the Infuse® Bone Graft/Interbody Fusion Device should have had at least 6 months of nonoperative treatment prior to treatment with the Infuse® Bone Graft/Interbody Fusion Device. (Note: A collagen sponge consists of the carrier, while the interbody fusion device is a delivery system. Use with posterior or transforaminal lumbar interbody fusion is considered off-label.) In 2015, FDA approved the use of Infuse® for oblique lateral interbody fusion from L2-S1. FDA product code: NEK.
Infuse® Bone Graft product is also approved for:

- For the treatment of acute, open fractures of the tibial shaft
- For sinus augmentations, and for localized alveolar ridge augmentations for defects associated with extraction sockets (P050053, March 2007).

OP-1® Putty was initially approved by FDA through the humanitarian device exemption (HDE) process for 2 indications:

- “OP-1 Implant is indicated for use as an alternative to autograft in recalcitrant long-bone nonunions where use of autograft is unfeasible and alternative treatments have failed.” FDA product code: MPW.
- “OP-1 Putty is indicated for use as an alternative to autograft in compromised patients requiring revision posterolateral (intertransverse) lumbar spinal fusion, for whom autologous bone and bone marrow harvest are not feasible or are not expected to promote fusion. Examples of compromising factors include osteoporosis, smoking and diabetes.” FDA product code: MPY.

Stryker Biotech sought FDA permission to expand the use of OP-1® Putty to include uninstrumented posterolateral lumbar spinal fusion for the treatment of lumbar spondylolisthesis. In 2009, an FDA advisory committee voted against the expanded approval. Olympus Biotech (a subsidiary of Olympus Corp.) acquired OP-1® assets in 2010. In 2014, Olympus closed Olympus Biotech operations in the United States and discontinued domestic sales of Olympus Biotech products. The rhBMP-7 product is no longer marketed in the United States.

Infuse® Bone Graft/LT-Cage™ Lumbar Tapered Fusion device is contraindicated in patients who are pregnant, may be allergic to any materials contained in the devices, have an infection near the area of the surgical incision, have had a tumor removed from the area of the implantation site, or currently have a tumor in that area, or who are skeletally immature.

In July 2008, FDA issued a public health notification on life-threatening complications associated with rhBMP in cervical spine fusion, based on reports of complications with of rhBMP in cervical spine fusion.(1) Complications were associated with swelling of neck and throat tissue, which resulted in compression of the airway and/or neurologic structures in the neck. Some reports describe difficulty swallowing, breathing, or speaking. Severe dysphagia following cervical spine fusion using rhBMP products has also been reported in the literature. As stated in the public health notification, the safety and efficacy of rhBMP in the cervical spine have not been demonstrated. These products are not approved by FDA for this use.

In 2011, Medtronic received a “nonapprovable letter” from FDA for AMPLIFY™. The AMPLIFY™ rhBMP-2 Matrix uses a higher dose of rhBMP (2.0 mg/mL) with a compression-resistant carrier.
**Rationale**

This evidence review was created in July 2004 and has been updated regularly with searches of the MEDLINE database. The most recent literature update was performed through July 20, 2017.

When this evidence review was created, randomized controlled trials (RCTs) supported the use of recombinant human bone morphogenetic protein-2 (rhBMP-2) in the treatment of anterior interbody spinal fusion when used with a tapered cage and in the treatment of open tibial fractures. A randomized study (2002) supported the use of rhBMP-7 in the treatment of recalcitrant nonunions of the long bones. It should be noted that most of these trials were designed to show that use of rhBMP was equivalent (not superior) to autologous bone grafting. The proposed advantage of rhBMP is the elimination of a separate incision site to harvest autologous bone graft and the associated pain and morbidity. However, a 2011 study by Howard et al raised questions about the magnitude of pain observed with iliac crest bone graft (ICBG) harvesting. In this study, 112 patients who had an instrumented posterolateral lumbar fusion at 1 or 2 levels were seen at a tertiary spine center for a routine postoperative visit. ICBG was harvested in 53 (47.3%) patients through the midline incision used for lumbar fusion, and rhBMP-2 was used in 59 (52.7%) patients with no graft harvest. An independent investigator not directly involved in patient care and was unaware of the type of bone graft used in the fusion examined each patient for tenderness over the surgical site as well as the left and right posterior iliac crest. At a mean follow-up of 41 months (range, 6-211 months), there was no significant difference between the groups in the proportion of patients complaining of tenderness over either iliac crest (mean pain score, 3.8 vs 3.6 on a 10-point scale). While 54% of patients complained of tenderness over 1 or both iliac crests, only 10 (9%) of 112 patients had pain over the crest from which the graft was harvested (mean pain score, 4.4).

**SPINAL FUSION**

In 2013, 2 meta-analyses on the effectiveness and harms of rhBMP-2 in spine fusion were published following a 2011 U.S. Senate investigation of industry influence on the Infuse clinical studies and a systematic review by Carragee et al of emerging safety concerns with rhBMP-2. The systematic review by Carragee compared conclusions about safety and efficacy from the 13 published rhBMP-2 industry-sponsored trials with available U.S. Food and Drug Administration data summaries, subsequent studies, and databases. Evaluation of the original trials suggested methodologic bias against the control group in the study design (discarding local bone graft and failure to prepare facets for arthrodesis) and potential bias (overestimation of harm) in the reporting of iliac crest donor site pain. Comparison between the published studies and Food and Drug Administration documents revealed internal inconsistencies and adverse events not reported in the published articles.

Both 2013 meta-analyses assessed individual patient-level data, published and unpublished, provided by the manufacturer through the Yale University Open Data
Access Project. One meta-analysis was conducted by Simmonds et al and the by Fu et al.

Simmonds et al (2013) included patient-level data from 12 RCTs (total N=1408 patients), regardless of spinal level or surgical approach, and adverse event data from an additional 35 observational studies.(5) Use of rhBMP-2 increased the rate of radiographic fusion by 12% compared with ICBG, with substantial heterogeneity across trials. A small improvement in the Oswestry Disability Index score (3.5 percentage points) fell below the previously defined threshold for a clinically significant effect. Reviewers also found a small improvement in back pain (1 point on a 20-point scale) and 36-Item Short-Form Health Survey Physical Component Summary score (1.9 percentage points). There was no significant difference between groups for leg pain. There was a potential for bias in the pain and functional outcomes because outcomes were patient-reported and patients were not blinded to the treatment received. Overall, the increase in successful fusion at up to 24 months did not appear to be associated with a clinically significant reduction in pain.

The systematic review by Fu et al (2013) included individual-patient data from 13 RCTs (total N=1981 patients) and 31 cohort studies.(6) Reviewers found moderate evidence of no consistent differences between rhBMP-2 and ICBG in overall success, fusion rates, or other effectiveness measures for anterior lumbar interbody fusion or posterolateral fusion. A small RCT and 3 cohort studies revealed no difference in effectiveness outcomes between rhBMP and ICBG for anterior cervical fusion. Reporting in the originally published trials was found to be biased, with the publications selecting analyses and results that favored rhBMP over ICBG.

Both meta-analyses suggested that cancer risk might be increased with rhBMP-2, although the number of events was low and there was heterogeneity in the types of cancer. In Simmonds, the combined analysis revealed a relative risk of 1.84 (95% confidence interval [CI], 0.81 to 4.16) for cancer in the bone morphogenetic protein (BMP) group, but this increased rate was not statistically significant. Fu performed a combined analysis of cancer incidence at 24 and 48 months posttreatment. At 24 months, there was a statistically significant increase in cancer for the BMP group (RR=3.45; 95% CI, 1.98 to 6.0); at 48 months, the increase was not statistically significant (RR=1.82; 95% CI, 0.84 to 3.95).

Other adverse events were increased for the BMP group. Simmonds found a higher incidence of early back and leg pain with rhBMP-2. The individual publications consistently reported increased rates of heterotopic bone formation, leg pain/radiculitis, osteolysis, and dysphagia, but combined analysis for these outcomes was not performed. Fu reported that BMP-2 was associated with a statistically nonsignificant increased in the risk for urogenital problems when used for anterior lumbar fusion and an increased in the risk for wound complications and dysphagia when used for anterior cervical spine fusion. Fu et al noted that the data on adverse events in the published literature was incomplete compared with the total amount of data available.
Off-label use of BMP can include multiple levels and dosages greater than the Food and Drug Administration-approved dose of rhBMP-2 for single-level fusion. In 2013, Carragee et al assessed cancer risk after high-dose rhBMP-2 (40 mg) using publicly available data from the pivotal, multicenter RCT of AMPLIFY (N=463).\(^\text{(9)}\) The study found an increase in the incidence of cancer, a reduction in the time to first cancer, and a greater number of patients with multiple cancers. For example, at 2 years, there were 15 new cancer events in 11 patients in the rhBMP-2 group compared with 2 new cancer events in 2 patients treated with autogenous bone graft (incidence rate ratio [IRR], 6.75). When calculated in terms of the number of patients with 1 or more cancer events 2 years after surgery, the incidence rate per 100 person-years was 2.54 in the rhBMP-2 group and 0.50 in the control group (IRR=5.04). The mean time to development of cancer was 17.5 months after use of rhBMP-2 and 31.8 months in the controls. Three patients, all in the rhBMP-2 group, developed multiple new cancers.

**LONG-BONE FRACTURES AND NONUNIONS**

In 2015, Dai et al published a meta-analysis on rhBMP for the healing of acute tibial fractures (4 RCTs; n=868 patients) and nonunions (4 RCTs; n=245 patients).\(^\text{(10)}\) For acute tibial fractures, 3 RCTs were conducted with rhBMP-2 and 1 with rhBMP-7. All included studies were conducted over a decade ago. Use of rhBMP was associated with a higher rate of union (RR=1.16) and a lower rate of revision (RR=0.68) than controls (3 trials with soft-tissue management, 1 with intramedullary nail plus autograft). There was no significant difference between the BMP and control groups for hardware failure or infection. For tibial fracture nonunions, 3 trials used rhBMP-7 and the fourth trial did not state which formulation. The relative risk was nearly 1 (0.98), and there was no significant difference between the BMP and intramedullary nail plus autograft groups in the rates of revision or infection. Interpreting these results is difficult given the variations in control groups and formulations of rhBMP used, one of which is no longer marketed in the United States.

A 2010 Cochrane review evaluated the comparative effectiveness and costs of rhBMP for healing of acute fractures and nonunions vs standard of care.\(^\text{(11)}\) The literature search was conducted to October 2008; (11) RCTs (total N=976 participants) and 4 economic evaluations selected for inclusion. The times to fracture healing were comparable between the rhBMP and control groups. There was some evidence for faster healing rates, mainly for open tibial fractures without secondary procedures (RR=1.19). Three trials indicated that fewer secondary procedures were required for acute fractures treated with rhBMP (RR=0.65). Reviewers concluded that limited evidence suggested rhBMP may be more effective than standard of care for acute tibial fracture healing; however, use of rhBMP for treating nonunion remains unclear (RR=1.02).

In 2013, Lyon et al reported on a manufacturer-funded, randomized, double-blind trial of injectable rhBMP-2 in a calcium phosphate matrix for closed tibial diaphyseal fractures.\(^\text{(12)}\) The trial had a target enrollment of 600 patients but was stopped after interim analysis with 387 patients enrolled. Addition of the injectable...
rhBMP-2 paste to the standard of reamed intramedullary nail fixation did not shorten the time to fracture healing, resulting in study termination due to futility.

OTHER SURGICAL PROCEDURES

Oral and Maxillofacial Procedures
A 2010 Agency for Healthcare Research and Quality technology assessment on the state of the evidence for on-label and off-label use of rhBMP(13) included the following conclusions:

- The strength of the body of evidence on clinical outcomes is moderate that rhBMP-2 does not provide an advantage in prosthesis implantation and functional loading compared with autograft plus allograft bone.
- There is moderate evidence that oral sensory loss associated with autograft bone harvest can be avoided by use of rhBMP-2.

Additional Applications
Some research has evaluated the use of following applications: management of early stages of osteonecrosis of the vascular head as an adjunct to hip arthroplasty to restore bone defects in the acetabulum or femoral shaft and as an adjunct to distraction osteogenesis (ie, Ilizarov procedure).(14,15) The literature on these applications consists of small case series; no controlled trials have been identified.

Section Summary: Other Surgical Procedures
The evidence does not support a health benefit for use of rhBMP with other surgical procedures, including oral and maxillofacial procedures.

SUMMARY OF EVIDENCE
For individuals who are undergoing anterior or posterolateral lumbar spinal fusion and in whom autograft is infeasible who receive rhBMP, the evidence includes randomized controlled trials (RCTs) and systematic reviews of RCTs. Relevant outcomes are symptoms, morbid events, functional outcomes, and treatment-related morbidity. In 2013, 2 systematic reviews of rhBMP-2 trials using manufacturer-provided individual patient data were published. Overall, these reviews found little to no benefit of rhBMP-2 over iliac crest bone graft for all patients undergoing spinal fusion, with an uncertain risk of harm. The small benefits reported do not support the widespread use of rhBMP-2 as an alternative to iliac crest autograft. However, the studies do establish that rhBMP-2 has efficacy in promoting bone fusion and will improve outcomes for patients for whom use of iliac crest bone graft is infeasible. The overall adverse event rate was low, though concerns remain about increased adverse event rates with rhBMP-2, including cancer. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who are undergoing surgery for acute tibial shaft fracture and in whom autograft is infeasible who receive rhBMP, the evidence includes RCTs and systematic reviews of the RCTs. Relevant outcomes are symptoms, morbid events,
functional outcomes, and treatment-related morbidity. Two systematic reviews have concluded that rhBMP can reduce reoperations rates compared with soft-tissue management with or without intramedullary nailing. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals undergoing other surgical procedures (eg, oral and maxillofacial, hip arthroplasty, distraction osteogenesis) who receive rhBMP, the evidence includes a health technology assessment and small case series. Relevant outcomes are symptoms, morbid events, functional outcomes, and treatment-related morbidity. The evidence does not permit conclusions about the effect of rhBMP for craniomaxillofacial surgery or tibial shaft fracture nonunion. The evidence is insufficient to determine the effects of the technology on health outcomes.

SUPPLEMENTAL INFORMATION

PRACTICE GUIDELINES AND POSITION STATEMENTS
Joint guidelines on lumbar spinal fusion from the American Association of Neurological Surgeons and the Congress of Neurological Surgeons were updated in 2014.(16) Both groups gave a grade B recommendation (multiple level II studies) for the use of recombinant human bone morphogenetic protein-2 (rhBMP-2) as a substitute for autologous iliac crest bone for anterior lumbar interbody fusion and single-level posterolateral instrumented fusion. Grade C recommendations were made for rhBMP-2 as an option for posterior lumbar interbody fusion and transforaminal lumbar interbody fusion, posterolateral fusion in patients older than 60 years, and as a graft extender for either instrumented or noninstrumented posterolateral fusions. The societies also gave a grade C recommendation (based on multiple level IV and V studies) that the use of rhBMP-2 as a graft option has been associated with a unique constellation of complications of which surgeons should be aware when considering this graft extender/substitute.

U.S. PREVENTIVE SERVICES TASK FORCE RECOMMENDATIONS
Not applicable.

MEDICARE NATIONAL COVERAGE
There are no national coverage determinations specifically related to bone morphogenetic proteins.

ONGOING AND UNPUBLISHED CLINICAL TRIALS
Some currently unpublished trials that might influence this review are listed in Table 1.

Table 1. Summary of Key Trials

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
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<tr>
<td>NCT02718131a</td>
<td>A Study of INFUSE Bone Graft (BMP-2) in the Treatment of Tibial Pseudarthrosis in</td>
<td>54</td>
<td>Dec 2021</td>
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<td>Neurofibromatosis Type 1 (NF1)</td>
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<td>NCT00984672</td>
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<td>Evaluation of Radiculitis Following Use of Bone Morphogenetic Protein-2 for Interbody Arthrodesis in Spinal Surgery</td>
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<td>Feb 2017</td>
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</tr>
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</table>

NCT: national clinical trial.

a Denotes industry-sponsored or cosponsored trial.

References:


**Billing Coding/Physician Documentation Information**

20930  Allograft, morselized, or placement of osteopromotive material, for spine surgery only (List separately in addition to code for primary procedure)

20999  Unlisted procedure, musculoskeletal system, general

**ICD10 Codes**

M51.06  Intervertebral disc disorders with myelopathy, lumbar region

M51.07  Intervertebral disc disorders with myelopathy, lumbosacral region

M51.16  Intervertebral disc disorders with radiculopathy, lumbar region

M51.17  Intervertebral disc disorders with radiculopathy, lumbosacral region

M51.36  Other intervertebral disc degeneration, lumbar region

M51.37  Other intervertebral disc degeneration, lumbosacral region

M80.021K;  Osteoporosis with current long bone pathological fracture codes with 7th digit “K” for subsequent encounter for fracture with nonunion

M80.022K;  7th digit “K” for subsequent encounter for fracture with nonunion

M80.029K;  

M80.031K;  

M80.032K;  

M80.039K;  

M80.051K;  

M80.052K;  

M80.059K;  

M80.061K;  

M80.062K;  

M80.069K;  

M80.821K;  

M80.822K;  

M80.829K;  

M80.831K;  

M80.832K;  

M80.839K;  

M80.851K;  

M80.852K;  

M80.859K;  

M80.861K;  

M80.862K;  

M80.869K  

M80.061A;  Osteoporosis with current pathological tibia fracture codes with 7th digit “A” for initial encounter for fracture

M80.062A;  

M80.069A;  

M80.861A;  

M80.862A;  

M80.869A  

M84.321K;  Stress fracture of long bones with 7th digit “K” for subsequent encounter for fracture with nonunion

M84.322K;  

M84.329K;  

M84.331K;
Stress fracture of tibia codes with 7th digit “A” for initial encounter for fracture

Long bone other pathological fracture codes with 7th digit “K” for subsequent encounter for fracture with nonunion
M84.629K; M84.631K; M84.632K; M84.633K; M84.634K; M84.639K; M84.651K; M84.652K; M84.653K; M84.661K; M84.662K; M84.663K; M84.664K; M84.669K
M84.461A; M84.462A; M84.561A; M84.562A; M84.661A; M84.662A
Long bone other pathological fracture codes with 7th digit “A” for initial encounter for fracture
M84.6461A; M84.6462A; M84.6561A; M84.6562A; M84.661A; M84.662A
M96.0 Pseudarthrosis after fusion or arthrodesis
M96.1 Postlaminectomy syndrome, not elsewhere classified
Humerus: Long bone fracture codes with 7th digit “K” for subsequent encounter for fracture with nonunion
S42.201K- S42.496K
Radius:
S52.101K- S52.189K; S52.301K- S52.599K
Ulna:
S52.201K- S52.299K; S52.601K- S52.699K
Femur:
S72.001K- S72.92xK
Tibia:
S82.101K- S82.399K
Fibula:
S82.401K- S82.499K
Fracture of tibial shaft code range with 7th digit “B” or “C” for initial encounter for open fracture
S82.201B- S82.299C
Physeal fracture of tibia or fibula code range with 7th digit “K” for subsequent encounter for fracture with nonunion
S89.001K- S89.399K
There is no specific CPT or HCPCS code for bone morphogenetic protein. In 2011, CPT code 20930 was revised to include BMP-type materials used in spine surgery:

In the setting of spinal fusion, bone morphogenetic proteins may be used primarily as an alternative to autologous bone grafting. Since harvesting of autologous bone graft is coded separately from the fusion procedure (ie, CPT codes 20936-20938), when bone morphogenetic protein is used as an alternative to the bone graft, these codes should no longer be reported. In contrast, the CPT code for treating tibial fracture nonunions with autograft (ie, CPT code 27724) includes the harvesting component, and, therefore, when bone morphogenetic protein is used as an alternative in this setting, presumably the associated physician’s work would be decreased, since no autologous harvest is required. Finally, for treatment of acute, open tibial fractures, bone morphogenetic protein is not used as an alternative to autologous bone graft, but in addition to standard treatment with an intramedullary nail.

**Additional Policy Key Words**

DBM
Demineralized bone matrix

**Policy Implementation/Update Information**

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
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<tbody>
<tr>
<td>5/1/06</td>
<td>New policy.</td>
</tr>
<tr>
<td>5/1/07</td>
<td>Policy statement revised. Limitation to single level spinal fusion deleted and type of carrier system deleted from policy statement.</td>
</tr>
<tr>
<td>5/1/08</td>
<td>No policy statement changes.</td>
</tr>
<tr>
<td>5/1/09</td>
<td>No policy statement changes.</td>
</tr>
<tr>
<td>5/1/10</td>
<td>Policy statements revised; rhBMP-2 considered medically necessary for instrumented posterolateral intertransverse fusion; rhBMP-7 considered medically necessary for non-instrumented posterolateral intertransverse fusion under specified conditions; other policy statements clarified.</td>
</tr>
<tr>
<td>5/1/11</td>
<td>No policy statement changes.</td>
</tr>
<tr>
<td>5/1/12</td>
<td>Use restricted to cases where there is a high risk of fusion failure.</td>
</tr>
<tr>
<td></td>
<td>Investigational policy statement clarified to include cervical spinal fusion.</td>
</tr>
<tr>
<td>5/1/13</td>
<td>No policy statement changes.</td>
</tr>
<tr>
<td>5/1/14</td>
<td>Medically necessary policy statement revised to clarify coverage is for skeletally mature patients. Policy statement regarding non-covered uses changed from investigational to not medically necessary.</td>
</tr>
<tr>
<td>5/1/15</td>
<td>No policy statement changes.</td>
</tr>
<tr>
<td>5/1/16</td>
<td>No policy statement changes.</td>
</tr>
<tr>
<td>5/1/17</td>
<td>Removed rhBMP-from policy statements.</td>
</tr>
<tr>
<td>12/1/17</td>
<td>The second (not medically necessary) statement is revised to add “Use of recombinant human bone morphogenetic protein (rhBMP-2) at the beginning, “and craniomaxillofacial surgery” at the end of this statement. Policy statements otherwise unchanged.</td>
</tr>
</tbody>
</table>
APPENDIX

Procedures used for lumbar interbody fusion differ primarily in the direction of approach to the spine, ie, from the front (anterior), from the back (posterior or transforaminal) or from the side (lateral). An alternative approach to interbody fusion is arthrodesis of the transverse processes alone (posterolateral), which does not fuse the adjoining vertebral bodies. Circumferential fusion fuses both the adjacent vertebral bodies and the transverse processes, typically using both an anterior and posterior approach to the spine.

Open and Minimally Invasive Approaches to Lumbar Interbody Fusion

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Access</th>
<th>Approach</th>
<th>Visualization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior (ALIF)</td>
<td>Open, MI, or laparoscopic</td>
<td>Transperitoneal or retroperitoneal</td>
<td>Direct, endoscopic or laparoscopic with fluoroscopic guidance</td>
</tr>
<tr>
<td>Posterior (PLIF)</td>
<td>Open or MI</td>
<td>Incision centered over spine with laminectomy/laminotomy and retraction of nerve</td>
<td>Direct, endoscopic or microscopic, with fluoroscopic guidance</td>
</tr>
<tr>
<td>Transforaminal (TLIF)</td>
<td>Open or MI</td>
<td>Offset from spine, through the intervertebral foramen via unilateral facetectomy</td>
<td>Direct, endoscopic or microscopic, with fluoroscopic guidance</td>
</tr>
<tr>
<td>Lateral Extreme lateral (XLIF)</td>
<td>MI</td>
<td>Retroperitoneal through transpsoas</td>
<td>Direct, with neurologic monitoring and fluoroscopic guidance</td>
</tr>
<tr>
<td>Direct lateral (DLIF)</td>
<td>MI</td>
<td>Transperitoneal through transpsoas</td>
<td>Direct, with neurologic monitoring and fluoroscopic guidance</td>
</tr>
</tbody>
</table>

LIF: lumbar interbody fusion; MI: minimally invasive.

Anterior Lumbar Interbody Fusion

Anterior access provides direct visualization of the disc space, potentially allowing a more complete discectomy and better fusion than lateral or posterior approaches. An anterior approach avoids trauma to the paraspinal musculature, epidural scarring, traction on nerve roots, and dural tears. However, the retraction of the great vessels, peritoneal contents, and superior hypogastric sympathetic plexus with a peritoneal or retroperitoneal approach place these structures at risk of iatrogenic injury. Access to the posterior space for the treatment of nerve compression is also limited. Laparoscopic anterior lumbar interbody fusion has also been investigated.

Posterior Lumbar Interbody Fusion

Posterior lumbar interbody fusion (PLIF) can be performed through either a traditional open procedure with a midline incision or with a minimally invasive approach using bilateral paramedian incisions. In the open procedure, the midline muscle attachments are divided along the central incision to facilitate wide muscle retraction and laminectomy. In minimally invasive PLIF, tubular retractors may be used to open smaller central bilateral working channels to access the pedicles and foramen. Minimally invasive PLIF typically involves partial laminotomies and facetectomies. The decompression allows treatment of spinal canal pathology (eg, spinal stenosis, lateral recess and foraminal stenosis, synovial cysts, hypertrophic ligamentum flavum), as well as stabilization of the spine through interbody fusion.
**Transforaminal Lumbar Interbody Fusion**
Transforaminal lumbar interbody fusion (TLIF) is differentiated from the more traditional bilateral PLIF by a unilateral approach to the disc space through the intervertebral foramen. In minimally invasive TLIF, a single incision about 2 to 3 cm in length is made approximately 3 cm lateral to the midline. A tubular retractor is docked on the facet joint complex and a facetectomy with partial laminectomy is performed. Less dural retraction is needed with access through the foramen via unilateral facetectomy, and contralateral scar formation is eliminated. TLIF provides access to the posterior elements along with the intervertebral disc space.

**Lateral Interbody Fusion**
Lateral interbody fusion (eg, extreme lateral interbody fusion or direct lateral interbody fusion) uses specialized retractors in a minimally invasive, lateral approach to the anterior spine through the psoas. In comparison with anterior lumbar interbody fusion, the lateral approach does not risk injury to the peritoneum or great vessels. However, exposure to the spine may be more limited, and dissection of the psoas major places the nerves of the lumbar plexus at risk. Electromyographic monitoring and dissection predominantly within the anterior psoas major may be utilized to reduce the risk of nerve root injury. These various factors decrease the ability to perform a complete discectomy and address pathology of the posterior elements.

**Circumferential Fusion**
Circumferential fusion is 360° fusion that joins vertebrae by their entire bodies and transverse processes, typically through an anterior and posterior approach.

**Posterolateral Fusion**
Posterolateral fusion is a procedure where the transverse processes of the involved segments are decorticated and covered with a mixture of bone autograft or allograft.