

Percutaneous Vertebroplasty and Kyphoplasty

Policy Number: CS330.B
Effective Date: July 1, 2022

[Instructions for Use](#)

Table of Contents	Page
Application	1
Coverage Rationale	1
Definitions	2
Applicable Codes	2
Description of Services	3
Clinical Evidence	3
U.S. Food and Drug Administration	13
References	14
Policy History/Revision Information	17
Instructions for Use	17

Commercial Policy

- [Percutaneous Vertebroplasty and Kyphoplasty](#)

Application

This Medical Policy does not apply to the states listed below; refer to the state-specific policy/guideline, if noted:

State	Policy/Guideline
Indiana	None
Kentucky	Percutaneous Vertebroplasty and Kyphoplasty (for Kentucky Only)
Louisiana	None
New Jersey	Percutaneous Vertebroplasty and Kyphoplasty (for New Jersey Only)
Pennsylvania	Percutaneous Vertebroplasty and Kyphoplasty (for Pennsylvania Only)
Tennessee	Percutaneous Vertebroplasty and Kyphoplasty (for Tennessee Only)

Coverage Rationale

Percutaneous vertebroplasty and kyphoplasty are proven and medically necessary for treating pain causing [Functional or Physical Impairment](#) in cervical, thoracic, or lumbar vertebral bodies within 4 months of pain onset that has failed to respond to optimal medical therapy for the following indications:

- Osteoporotic vertebral compression fracture (VCF)
- Steroid-induced vertebral fracture
- Osteolytic metastatic disease involving a vertebral body
- Multiple myeloma involving a vertebral body
- Vertebral Hemangioma with aggressive features
- Unstable fractures due to Osteonecrosis (e.g., Kummel disease)

and

Computed tomography (CT) or magnetic resonance imaging (MRI) has ruled out other causes of spinal pain, including but not limited to:

- Foraminal stenosis
- Facet arthropathy

- Herniated intervertebral disk
- Other spinal degenerative disease
- Other significant coexistent spinal or bony pain generators

and

The following are not present:

- Clinical evidence of spinal cord compression as confirmed by CT or MRI; or
- Significant vertebral collapse or destruction (e.g., vertebra reduced to less than one-third of its original height) as confirmed by CT or MRI; or
- Healed VCF as confirmed by CT or MRI; or
- Lesions of the sacrum or coccyx (refer to the Medical Policy titled [Surgical Treatment for Spine Pain](#) for additional information on percutaneous sacral augmentation); or
- Asymptomatic vertebral compression fractures (VCFs); or
- VCFs responding appropriately to conservative therapy

Percutaneous vertebroplasty and kyphoplasty are unproven and not medically necessary for treating indications other than those listed above due to insufficient evidence of efficacy.

Definitions

Functional or Physical Impairment: A functional or physical or physiological impairment causes deviation from the normal function of a tissue or organ. This results in a significantly limited, impaired, or delayed capacity to move, coordinate actions, or perform physical activities and is exhibited by difficulties in one or more of the following areas: physical and motor tasks; independent movement; performing basic life functions.

Osteonecrosis: Osteonecrosis (also referred to as avascular necrosis, aseptic necrosis, pseudarthrosis, or Kummel disease) is a disease caused by reduced blood flow to bones in the joints. With decreased blood flow, the bone may break down. Known causes of Osteonecrosis are steroid medications, alcohol use, injury, and increased pressure inside the bone. Risk factors are radiation treatment, chemotherapy, kidney, and other organ transplants. Nonsurgical treatments may relieve pain in the short term, but they do not cure the disease (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2014).

Vertebral Hemangiomas: Vertebral Hemangiomas are benign vascular tumors of the bony spine which are usually asymptomatic. A rare subset of them are characterized by extra-osseous extension, bone expansion, disturbance of blood flow, and occasionally compression fractures and thereby referred to as aggressive hemangiomas. Aggressive Vertebral Hemangiomas most often occur between T3 and T9 vertebral segments (Schrock, 2011).

Applicable Codes

The following list(s) of procedure and/or diagnosis codes is provided for reference purposes only and may not be all inclusive. Listing of a code in this policy does not imply that the service described by the code is a covered or non-covered health service. Benefit coverage for health services is determined by the member specific benefit plan document and applicable laws that may require coverage for a specific service. The inclusion of a code does not imply any right to reimbursement or guarantee claim payment. Other Policies and Guidelines may apply.

CPT Code	Description
22510	Percutaneous vertebroplasty (bone biopsy included when performed), 1 vertebral body, unilateral or bilateral injection, inclusive of all imaging guidance; cervicothoracic
22511	Percutaneous vertebroplasty (bone biopsy included when performed), 1 vertebral body, unilateral or bilateral injection, inclusive of all imaging guidance; lumbosacral
22512	Percutaneous vertebroplasty (bone biopsy included when performed), 1 vertebral body, unilateral or bilateral injection, inclusive of all imaging guidance; each additional cervicothoracic or lumbosacral vertebral body (List separately in addition to code for primary procedure)

CPT Code	Description
22513	Percutaneous vertebral augmentation, including cavity creation (fracture reduction and bone biopsy included when performed) using mechanical device (e.g., kyphoplasty), 1 vertebral body, unilateral or bilateral cannulation, inclusive of all imaging guidance; thoracic
22514	Percutaneous vertebral augmentation, including cavity creation (fracture reduction and bone biopsy included when performed) using mechanical device (e.g., kyphoplasty), 1 vertebral body, unilateral or bilateral cannulation, inclusive of all imaging guidance; lumbar
22515	Percutaneous vertebral augmentation, including cavity creation (fracture reduction and bone biopsy included when performed) using mechanical device (e.g., kyphoplasty), 1 vertebral body, unilateral or bilateral cannulation, inclusive of all imaging guidance; each additional thoracic or lumbar vertebral body (List separately in addition to code for primary procedure)

CPT® is a registered trademark of the American Medical Association

Description of Services

Percutaneous vertebroplasty is a therapeutic, interventional radiologic procedure, which involves injection of an acrylic polymer, such as polymethylmethacrylate (PMMA) into a vertebral body fracture in an effort to relieve pain and provide stability. This procedure is used primarily for osteoporotic vertebral compression fractures or osteolytic vertebral lesions that are refractory to medical therapy. Medical management of vertebral body fractures can include analgesics, bed rest, and external bracing; however, despite these types of management, progressive kyphosis, prolonged pain, and disability still occur in some individuals. In these individuals, percutaneous vertebroplasty can be used to prevent further collapse of fractured vertebrae, and to augment osteoporotic vertebral bodies at risk for fracture.

Kyphoplasty (KP) (also known as balloon-assisted vertebroplasty or vertebral augmentation) is a modification of vertebroplasty. The procedure involves guided insertion of an inflatable bone tamp into the partially collapsed vertebral body. Once in place, the balloon is expanded to the desired height and removed. An acrylic polymer is then injected into the space, where it hardens and binds to the vertebral body. KP is intended to relieve pain and improve function and quality of life by restoring vertebral height and integrity.

The primary difference in the case of kyphoplasty is that the fracture itself is at least partially reduced by expanding the intrabody space by the use of inflatable bone tamps. Once the compression is reduced to an acceptable degree, the bone cement is then injected. In this way, some of the bony deformity and resulting kyphosis may be reduced, often significantly improving the individual's pain.

Painful vertebral compression fractures may cause a marked decline in physical activity and quality of life, leading to general physical deconditioning. This, in turn, may prompt further complications related to poor inspiratory effort (atelectasis and pneumonia) and venous stasis (deep venous thrombosis and pulmonary embolism). Successful management of painful vertebral compression fractures has the potential for improving quality of life, increasing the expectancy of an independent and/or productive life, and preventing superimposed medical complications (American College of Radiology, 2018).

Clinical Evidence

There is a broad consensus based on the review of clinical literature and professional organization that percutaneous vertebral augmentation with the use of vertebroplasty or kyphoplasty (KP) is a safe, efficacious, and durable procedure in selected patients with symptomatic osteoporotic and neoplastic fractures. There is inadequate clinical evidence of safety and/or efficacy in published, peer-reviewed literature for treatment of other indications.

Osteoporotic Vertebral Compression Fractures (VCFs) An updated 2021 Hayes Health Technology Assessment reported on percutaneous kyphoplasty (KP) for osteoporotic vertebral compression fractures. The report included ten studies: six randomized controlled trials (RCTs) (eight publications), one quasi-RCT, and three database studies. The sample size was 59 to 1,038,956 patients with VCFs due to osteoporosis with a 6 month to 4 years follow-up. The authors concluded that there is moderate-quality evidence that KP may be beneficial to some patients with a VCF due to osteoporosis that have not responded to conservative treatment (CT). There is consistent evidence that KP and VP provide similar improvements in pain, disability,

and QOL from baseline. There is limited evidence that KP is favored over CT for pain relief. Large, fair-quality database analyses offer limited but consistent evidence of lower mortality risk in patients treated with KP compared with those treated with VP. In addition, limited evidence from these database studies suggested that VP is associated with a higher risk for some postoperative complications (e.g., pulmonary embolism, deep vein thrombosis, and pneumonia). (Hayes, 2017, updated 2021).

A 2016 Hayes Health Technology Assessment, updated in 2021, reviewed comparative effectiveness of percutaneous vertebroplasty versus sham, conservative treatment, or kyphoplasty for osteoporotic vertebral compression fractures. The evidence comprised 19 studies: 15 RCTs, one quasi-RCT, and three database studies. The sample sizes were 49 to 1,038,956 patients with VCFs due to osteoporosis with a follow-up of 6 months to 4 years. The authors reported that moderate-quality evidence found that for patients with acute pain, pain relief was better for VP versus sham or CT in four of ten studies, and was similar to comparators (sham, facet block, kyphoplasty) in six of ten studies. For patients with chronic pain, VP was favored over CT in three of five studies, was equivocal relative to sham in one study, and was similar to kyphoplasty in one of five studies. Findings were generally similar for disability and QOL. The most reported adverse events across studies were the occurrence of additional VCFs following treatment and cement leakage. The 2021 annual review included two new key studies with no change to the evidence or conclusion.

Li, Cai & Cong (2021) performed a systematic review and meta-analysis comparing the safety and efficacy of vertebral augmentation (VA) with non-surgical management (NSM) for treatment of osteoporotic OVCFs. The study included 20 randomized controlled trials involving 2,566 patients with painful OVCFs. There were no significant differences between PVP and sham procedure VAS scores at most time points during follow-up period. In a subgroup analysis based on fracture type and fracture location, significant differences of VAS were found between PVP and CT and were not found between PVP and sham procedure. In a subgroup analysis of duration of back pain, significant differences were found between PVP and CT in VAS at 1 week, 3 months, and 1 year. The differences of VAS were not significant between PVP and CT at 1 month and 6 months. The authors concluded that VA is safe and effective for treatment of painful OVCFs with good clinical outcomes compared to patients undergoing conservative NSM. [Authors Berenson et al. (2011), Boonen et al. (2011), Blasco et al. (2012), Chen et al. (2014), Farrokhi et al. (2011), Firanesco et al. (2018), Kallmes et al. (2009), and Klazen et al. (2010), which were previously cited in this policy, are included in this systematic and meta-analysis review].

Hinde et al. (2020) performed a systematic review and meta-analysis comparing mortality benefits of individuals with osteoporotic vertebral compression fractures (OVCFs) who have undergone VA versus those who received non-surgical management (NSM). A total of 16 studies including more than 2 million patients with OVCF (VA = 382,070, NSM = 1,707,874) were included in the review. Only seven studies were included in the meta-analysis. Results showed hazard ratios (HRs) for mortality benefit for VA versus NSM over a two- and five-year period as 0.78 ($P < .001$) and 0.79 ($P = .05$). Pooled hazard ratio for mortality comparing VA with conservative management was 0.78 ($P = .003$) at up to 10 years. Balloon kyphoplasty provided a mortality benefit over VA with a hazard ratio of 0.77 versus 8.87 ($P < .001$). The authors concluded that VA offers survival benefits when treating OVCFs and should be offered in carefully selected patients as a best clinical practice. Osteoporotic vertebral compression fractures who underwent vertebral augmentation were 22% less likely to die at up to 10 years after treatment than those who received nonsurgical treatment.

Wei et al. (2020) performed a systematic review and meta-analysis to compare clinical outcomes of PVP versus PKP for treatment of osteoporotic vertebral compression fractures (OVCFs) with intravertebral cleft (IVC). The review included 688 patients in nine studies: 378 patients were treated with PVP and 310 patients with PKP. The authors stated the results indicated no significant differences between the two groups in the short-and long-term VAS, ODI, LKA, or VH% ($P > 0.05$). PKP was associated with significantly longer operation time, higher cost, and more injected cement volume. PKP had a lower risk of cement leakage. There was no significant difference in adjacent-level fracture rates. The authors concluded that both PVP and PKP are safe and effective minimally invasive options for treatment of OVCFs.

Liu et al. (2019) performed a randomized controlled trial to assess the effect of BKP on elderly patients with multiple osteoporotic vertebral fractures. The observation group was treated with BKP, and the control group was managed with conservative treatment. Image indices, pain degree, daily life disturbance, and occurrences of complications were compared between the two groups. One hundred sixteen elderly patients with multiple osteoporotic vertebral fracture divided randomly into observation ($n = 58$) and control groups ($n = 58$). The observation group showed a significantly higher trailing edge, leading edge, and midcourt line and larger upper thoracic kyphosis compared with the control group. Before the treatment, no statistically significant differences were observed between the two groups in terms of visual analog scale (VAS) score and daily life disturbance score. The VAS score and the daily life disturbance score of the two groups decreased sharply after the

treatment. Moreover, the VAS score and the daily life disturbance score of the observation group were significantly lower than those of the control group. The observation group showed lower occurrence rate of complications compared with the control group. The authors concluded that BKP can significantly improve the image indices of patients with multiple osteoporotic vertebral fractures and relieve their pain degree and daily life disturbance. BKP exhibited a low occurrence rate of complications and high safety.

A pilot monocenter prospective study (Noriega et al., 2019) in 30 patients with painful osteoporotic vertebral compression fractures compared two vertebral augmentation procedures. Patients were randomized to SpineJack® (SJ) (n = 15) or balloon kyphoplasty (BKP) (n = 15). Clinical endpoints were analgesic consumption, back pain intensity (visual analog scale (VAS), the Oswestry Disability Index (ODI), and quality of life (EQ-VAS score). They were recorded preoperatively, at 5 days (except EQ-VAS), 1, 3-, 6-, 12-, and 36-months post-surgery. Spine X-rays were taken 48 hours prior to the procedure and 5 days, 6-, 12-, and 36-months after. Over a 3-year post-surgery follow-up, pain/disability/quality of life remained significantly improved with both BKP and SpineJack® techniques, but the latter allowed better vertebral body height restoration/kyphosis correction. Preliminary results showed that SJ resulted in a better restoration of vertebral heights and angles, maintained over 12 months.

Buchbinder et al. (2018) conducted a Cochrane review in order to update the clinical evidence on the benefits and harms of vertebroplasty for treatment of osteoporotic vertebral fractures. Randomized and quasi-RCTs of adults with painful osteoporotic vertebral fractures, comparing vertebroplasty with placebo (sham), usual care, or another intervention were included. As it is least prone to bias, vertebroplasty compared with placebo was the primary comparison. Major outcomes were mean overall pain, disability, disease-specific and overall health-related quality of life, patient-reported treatment success, new symptomatic vertebral fractures, and number of other serious adverse events. Based upon high- to moderate-quality evidence, the authors' updated review does not support a role for vertebroplasty for treating acute or subacute osteoporotic vertebral fractures in routine practice. The authors found no demonstrable clinically important benefits compared with placebo (sham procedure) and subgroup analyses indicated that the results did not differ according to duration of pain ≤ 6 weeks versus > 6 weeks. Sensitivity analyses confirmed that open trials comparing vertebroplasty with usual care are likely to have overestimated any benefit of vertebroplasty. Numerous serious adverse events have been observed following vertebroplasty. Due to the small number of events, they stated that they could not be certain about whether or not vertebroplasty results in a clinically important increased risk of new symptomatic vertebral fractures and/or other serious adverse events. In the authors' opinion, patients should be informed about both the high- to moderate-quality evidence that shows no important benefit of vertebroplasty and its potential for harm.

Pourtaheri et al. (2018) conducted a systematic review and meta-analysis to (i) assess the clinical outcomes with and without vertebral augmentation (VA) for osteoporotic vertebral compression fractures (VCFs) with versus without correlating signs and symptoms; and (ii) acute (symptoms < 3 -month duration) and subacute VCFs (3-6-month duration) versus chronic VCFs (> 6 months). Thirteen studies totaling 1,467 patients with minimum 6-month follow-up were found. Pain reduction was greater with VA over conservative management for SVFs and equivalent for RVFs. Sub analysis for acute/subacute SVFs and chronic SVFs showed that VA was superior to nonoperative care. No difference was observed in outcomes between VA and nonoperative care for chronic RVF. The authors concluded that VA is superior to nonoperative care in reducing lower back pain for osteoporotic VCFs with correlating signs and symptoms. VA had no benefit over nonoperative care for chronic VCFs that lacked clinical correlation. The authors also note that lower back pain has many etiologies and patients should be clinically assessed before recommending VA.

Wang and colleagues (2018) completed a systematic review and meta-analysis which included a total of 16 studies and was aimed at exploring the overall safety and efficacy of BKP versus PVP for osteoporotic vertebral compression fracture (OVCF). The qualified studies included randomized controlled trials (n = 1), prospective or retrospective comparative studies, and cohort studies. The results indicated that KP significantly decreased the kyphotic wedge angle (SMD, 0.98; 95% CI 0.40-1.57), increased the postoperative vertebral body height (SMD, - 1.27; 95% CI - 1.86 to - 0.67), and decreased the risk of cement leakage (RR, 0.62; 95% CI 0.47-0.80) in comparison with vertebroplasty. However, there was no statistical difference in visual analog scale (VAS) scores (WMD, 0.04; 95% CI - 0.28-0.36) and Oswestry Disability Index (ODI) scores (WMD, - 1.30; 95% CI - 3.34-0.74) between the two groups. The authors concluded that KP contributes especially to decreasing the mean difference of kyphotic wedge angle and risk of cement leakage and increasing the vertebral body height when compared with vertebroplasty. But radiographic differences did not significantly influence the clinical results (no significant difference was observed in VAS scores and ODI scores between the two groups); thus, KP and PVP are equally effective in the clinical outcomes of OVCF. Furthermore, the authors indicated that more high-quality multi-center RCTs with a larger sample size and

longer follow-up are warranted to confirm the current findings. The findings are limited by inclusion of mostly observational studies.

A systematic review and network meta-analysis was conducted by Zuo et al. (2018). Randomized, controlled trials (RCTs) were compared percutaneous vertebroplasty (PVP), percutaneous kyphoplasty (PKP), nerve block (NB), or conservative treatment (CT) for treating osteoporotic vertebral compression fractures (OVCFs). A total of 18 trials among 1,994 patients were included. PKP was first option in alleviating pain in the case of the acute/subacute OVCFs for long term, and chronic OVCFs for short term and long term, while PVP had the most superiority in the case of the acute/subacute OVCFs for short term. NB ranks higher probability than PKP and PVP on acute/subacute OVCFs in short and long-term, respectively. The authors concluded that the results suggest that PVA (PVP/PKP) had better performance than CT in alleviating acute/subacute and chronic OVCFs pain for short- and long-term and that NB may be used as an alternative or before PVA, for pain relief. The findings are limited by the inherent indirectness of network meta-analyses. [Authors Evans et al. (2016), Farrokhi et al. (2011), Klazen et al. (2010), and Wang (2016), which were previously cited in this policy, are included in this systematic review].

In a systematic review of pain, quality of life and safety outcomes of BKP compared to other surgical techniques and non-surgical management for vertebral compression fractures (VCF), a task force of the American Society of Bone and Mineral Research (ASBMR) evaluated ten unique trials (1,837 participants). BKP in comparison to non-surgical management, was associated with greater reductions in pain, back-related disability, and better quality of life that appeared to lessen over time, but were less than minimally clinically important differences. Risk of new VCF at 3 and 12 months was not significantly different. Individuals with painful VCF experienced symptomatic improvement compared with baseline with all interventions. There were no significant differences between BKP and PVP in back pain, back disability, quality of life, risk of new VCF or any adverse events. Limitations of the studies included lack of a balloon kyphoplasty versus sham comparison, availability of only one randomized controlled trial of BKP versus non-surgical management, and lack of study blinding. The Task Force recommends well-conducted randomized trials comparing BKP with sham to help resolve remaining uncertainty about the relative benefits and harms of this procedure (Rodriguez et al., 2017). [Author Boonen et al. (2011), which were was previously cited in this policy, are included in this systematic review].

A meta-analysis of randomized controlled trials (RCTs) by Xie et al. (2017) aimed to evaluate the efficacy and safety in percutaneous vertebroplasty (PVP) and conservative treatment (CT) for osteoporotic vertebral compression fractures (OVCFs). Twelve RCTs with a total 1,231 patients (623 in the PVP and 608 in the CT) were included. Patients were followed up for at least 2 weeks in all the studies. Statistical differences were found between pain relief and Quality of Life Questionnaires. No statistical differences were found between pain relief and the rate of adjacent vertebral fracture. PVP is associated with higher pain relief than CT in the early period. PVP did not increase the rate of adjacent vertebral fracture. The authors concluded that the results indicate that PVP is a safe and effective treatment for OVCFs. [Authors Blasco et al. (2012), Chen et al. (2014), Farrokhi et al. (2011), and Klazen et al. (2010), which were previously cited in this policy, are included in this meta-analysis review].

Zhang et al. (2017) conducted a meta-analysis to evaluate whether PVP or BKP for osteoporotic vertebral compression fractures increase the incidence of new vertebral fractures. Twelve studies and 1,328 patients were included; 768 underwent a surgical procedure, and 560 received non-operative treatments. For new-level vertebral fractures, the meta-analysis found no significant difference between the two methods, including total new fractures ($P = 0.55$) and adjacent fractures ($P = 0.5$). For pre-existing vertebral fractures, there was no significant difference between the two groups (operative and non-operative groups) ($P = 0.24$). Additionally, there was no significant difference in bone mineral density, both in the lumbar ($P = 0.13$) and femoral neck regions ($P = 0.37$), between the 2 interventions. The analysis did not reveal evidence of an increased risk of fracture of vertebral bodies, especially those adjacent to the treated vertebrae, following augmentation with either method compared with conservative treatment. [Authors Klazen et al. (2010), which were previously cited in this policy, are included in this meta-analysis review].

Zhao et al. (2017) performed a network meta-analysis to assess the efficacy and safety of vertebroplasty (VP), kyphoplasty (KP), and conservative treatment (CT) for the treatment of osteoporotic vertebral compression fractures (OVCFs). Sixteen RCTs with 2,046 participants were included. Compared with CT, patients treated with VP had improved pain relief, daily function, and quality of life; however, no significant differences were found between VP and KP for these three outcomes. All treatment options were associated with comparable risk of new fractures. VP was the most effective treatment for pain relief, followed by KP and CT; conversely, KP was the most effective in improving daily function and quality of life and decreasing the incidence of new fractures, followed by VP and CT. The authors concluded that VP might be the best option when pain relief is the principle aim of therapy, but KP was associated with the lowest risk of new fractures and might offer better outcomes in terms of daily

function and quality of life. The findings are limited by the inherent indirectness of network meta-analyses. [Authors Blasco et al. (2012), Boonen et al. (2011), Farrokhi et al. (2011), and Klazen et al. (2010), which were previously cited in this policy, are included in this meta-analysis review].

Mattie et al. (2016) compared the degree and duration of pain relief following percutaneous vertebroplasty (PVP) with that following conservative treatment and/or sham for osteoporotic compression fractures by means of meta-analysis of randomized controlled trials. Based on their analysis, up to 1 year postoperatively, the effect of PVP exceeded the effect of conservative therapy with respect to pain relief in patients with osteoporotic compression fractures. The effect size was significant and close to the minimal clinically important difference. Those receiving PVP (531 out of 1,048 patients) had a significantly lower pain level compared with the control group at 1 to 2 weeks, 2 to 3 months, and 12 months. Based on their observations, the authors concluded that the effect of PVP exceeded the effect of conservative therapy up to 1 year postoperatively with respect to pain relief in patients with osteoporotic compression fractures. The effect size was significant and close to the minimal clinically important difference.

Gu et al. (2016) performed a systematic review and meta-analysis of studies comparing the outcomes of PVP and KP in the treatment of vertebral compression fractures, which included prospective, non-randomized, retrospective, comparative, and randomized studies. No significant difference was found between PVP and KP in short- and long-term pain and disability outcomes. The authors concluded that further studies are needed to better determine if any particular subgroups of patients would benefit more from PVP or KP in the treatment of vertebral body compression fractures. The findings are limited by inclusion of observational studies.

Yuan et al. (2016) conducted a meta-analysis to examine vertebroplasty or BKP for osteoporotic compression fractures compared to conservative treatment. The authors' review determined that overall vertebroplasty and KP reduce pain and improve function and quality of life as compared with conservative treatment. However, analysis by surgery type indicated that pain relief of kyphoplasty was similar to that of conservative management, but pain relief of vertebroplasty was greater than that of conservative management. Both procedures improved functional outcomes to a greater degree than conservative treatment, and that while KP improved quality of life to a greater degree than conservative treatment, there was no difference in quality-of-life improvement between vertebroplasty and conservative treatment. These results need to be interpreted with caution, however, as only two studies examined KP and only one of these studies examined function and quality of life. [Authors Blasco et al. (2012), Chen et al. (2014), Boonen et al. (2011), Farrokhi et al. (2011), and Klazen et al. (2010), which were previously cited in this policy, are included in this meta-analysis review].

Tan et al. (2015) conducted a prospective study of percutaneous vertebroplasty (PVP) for chronic painful osteoporotic vertebral compression fracture. Sixty-two consecutive patients with chronic painful osteoporotic VCFs for ≥ 3 months underwent PVP on 92 vertebrae in 73 procedures three to five days after referral. All procedures were performed under local anesthesia. The outcomes were pain relief at one week, one month, three months, six months and one year, as measured by visual analogue scale, Oswestry Disability Index, Quality of Life Questionnaire of the European Foundation for Osteoporosis (QUALEFFO) and Roland Morris Disability Questionnaire scores. According to the authors, the PVP procedures were technically successful and well tolerated in all patients. Compared with baseline scores, improvement in visual analogue scale, Oswestry Disability Index, QUALEFFO and Roland Morris Disability Questionnaire scores was significantly greater after PVP at one week ($P < 0.001$), one month ($P < 0.001$), three months ($P < 0.001$), six months ($P < 0.001$) and one year ($P < 0.001$), and the number of patients using drugs for pain treatment was significantly reduced. Five new fractures were reported in five of 62 patients treated with PVP during follow-up. The authors concluded that PVP is effective in patients with chronic painful osteoporotic VCFs due to immediate pain relief that was sustained for one year and may be an important factor for reducing persistent pain. The findings are, however, limited by the lack of comparison group,

In a systematic review, Stevenson et al. (2014) evaluated the clinical effectiveness of percutaneous vertebroplasty (PVP) and balloon kyphoplasty (BKP) in reducing pain and disability in people with osteoporotic vertebral compression fractures (VCFs). Inclusion criteria were randomized controlled trials for VCFs treated with their PVP or BKP. Primary outcomes were health-related quality of life; back-specific functional status/mobility; pain/analgesic use; vertebral body height and angular deformity; incidence of new vertebral fractures and progression of treated fracture. A total of nine RCTs were identified and included in the review of clinical effectiveness. This body of literature was of variable quality, with the two double-blind, OPLA-controlled trials being at the least risk of bias. The most significant methodological issue among the remaining trials was lack of blinding for both study participants and outcome assessors. According to the authors, broadly speaking, the literature suggests that both PVP and BKP provide substantially greater benefits than OPM in open-label trials. However, in double-blinded trials PVP

was shown to have no more benefit than local anesthetic; no trials of BKP compared with local anesthesia have been conducted. The authors concluded that for people with painful osteoporotic VCFs refractory to analgesic treatment, PVP and BKP perform significantly better in unblinded trials than OPM in terms of improving quality of life and reducing pain and disability. However, there is as yet no convincing evidence that either procedure performs better than OPLA. They further commented that data on key parameters were uncertain and/or potentially confounded, making definitive conclusions difficult to make. [Authors Blasco et al. (2012), Farrokhi et al. (2011), and Boonen et al. (2011), which were previously cited in this policy, are included in this systematic review].

In a meta-analysis of randomized controlled trials, Liu et al. (2013) compared the amount of pain reduction measured using the visual analog scale (VAS) when osteoporotic vertebral compression fractures are treated with percutaneous vertebroplasty (PVP) or conservatively. They also assessed the clinical utility of PVP. Five randomized controlled trials met the analysis criteria; conservative treatments used as comparators in these trials were different. There was no difference in pain relief in the PVP group at 2 weeks and one month when compared with the conservatively managed group. Pool results from the five studies showed that pain relief in the PVP group was greater than that of the conservative group at 3 months, 6 months, and 12 months. However, after subgroup analysis, pain scores were similar between the PVP group and the sham injection group from 2 weeks to 6 months. Compared with non-operative therapy, PVP reduced pain at all times studied. The authors concluded that PVP has some value for relieving pain; however, the possibility of a placebo effect should be considered. They recommend more large scale, double-blinded, controlled trials in order to quantify the pain relief afforded by PVP more precisely. [Authors Blasco et al. (2012), Chen et al. (2014), Farrokhi et al. (2011), & Klazen et al. (2010), which were previously cited in this policy, are included in this meta-analysis].

Shi et al. (2012) performed a meta-analysis to determine whether, when compared to non-operative management or sham procedures, percutaneous vertebroplasty (PVP) provided greater improvement in pain and pain-related disability for patients with vertebral compression fractures. Using a random effects model, the authors calculated the weighted mean differences to evaluate the pain reduction at different times as the primary outcome. Pain-related disability was assessed by a quality of life (QOL) measure. Improvement of QOL and recurrence of vertebral fractures were the secondary outcomes. The authors used subgroup analysis to reinvestigate pain relief and function improvement of PVP based on two different controls: nonoperative therapy and sham injection. The total number of patients was 886. Based on the outcome of their review, pain scoring was similar between the PVP group and the sham injection group at 1 to 29 days and 90 days. However, compared with nonoperative therapy, PVP reduced pain at all times studied. QOL in the PVP group was improved or tended to be improved compared with QOL for both control groups. The risk of new fractures was similar between the PVP groups and both control groups. They noted that different control groups may have accounted for the different conclusions in the literature regarding the ability of PVP to relieve pain and restore function recovery. Compared with nonoperative treatment PVP relieved pain better and improved QOL. PVP did not increase the risk of new fractures. [Authors Kallmes et al. (2010), Farrokhi et al. (2011), and Klazen et al. (2010), which were previously cited in this policy, are included in this meta-analysis review].

Osteolytic Metastatic Disease Involving a Vertebral Body

Astur and Aanzi conducted a systematic review (2019) of randomized controlled trials to assess the efficacy of kyphoplasty (KP) in controlling pain and improving quality of life in oncologic patients with metastatic spinal disease and pathologic compression fractures of the spine. After a literature search through medical databases, two studies with a combined total of 181 patients, met inclusion criteria. A meta-analysis was not possible due to data heterogeneity and individual analysis of studies was performed. There was moderate evidence that patient treated with balloon kyphoplasty (BKP) displayed better scores for pain (Numeric Rating Scale), disability (Roland-Morris Disability Questionnaire), quality of life (Short Form-36-Health Survey), and functional status (Karnofsky Performance Status) compared with those undergoing conventional treatment. Patients treated with KP also had better recovery of vertebral height. The authors concluded that although balloon kyphoplasty (KP) could be considered as an early treatment option for patients with symptomatic neoplastic spinal disease, further randomized clinical trials should be performed for improvement of the quality of evidence [Authors Berenson et al. (2011), which were previously cited in this policy, are included in this systematic review].

Sorensen et al. (2019) performed a systematic review evaluating the effectiveness and safety of vertebral augmentation for malignant vertebral compression fractures (VCFs). Studies on percutaneous vertebroplasty (PVP) or percutaneous kyphoplasty (KP) for vertebral compression fractures (VCFs) in patients with malignant spinal lesions were reviewed. The review identified two randomized controlled trials, 16 prospective studies, 44 retrospective studies, and 25 case series for a patient sample size of 3,426. At the earliest follow-up, pain improved from 7.48 to 3.00 with PVP, and from 7.05 to 2.96 with KP. ODI improved from 74.68 to 17.73 with PVP, and from 66.02 to 34.73 with KP. KPS improved from 66.99 to 80.28. Cement leakage was seen in

37.9% and 13.6% of patients treated with PVP and KP, respectively. Symptomatic complications (n = 43) were rare. The authors concluded that the review showed clinically relevant improvements in pain, ODI, and KPS in patients with VCFs due to malignancy treated with either PVP or KP. Cement leakage is common, but rarely symptomatic. The authors conclude that PVP and KP are safe and effective palliative procedures for painful VCFs in patients with malignant spinal lesions. [Authors Anselmetti et al. (2012), Berenson et al. (2011), Farrokhi et al. (2012) and Sun et al. (2014), which were previously cited in this policy, are included in this systematic review].

A systematic review was conducted by Sadeghi-Naini et al. (2018) to assess the effects of vertebroplasty (VP) and kyphoplasty (KP) compared with each other, usual care, or other treatments on pain, disability, and quality of life following metastatic spinal lesions (MSL). Nine trials were included in the qualitative analysis. In total, there were 622 patients enrolled in the trials and of them 432 were in the surgical treatment group (92 received KP, 97 received VP, 134 received VP and chemotherapy, 68 received VP and radiotherapy, and 41 received Kiva implant) and 190 were in the nonsurgical treatment group (83 received chemotherapy, 46 received radiotherapy, and 61 received other treatment). Using the grading of recommendations assessment, development and evaluation approach, pain (low-quality evidence) and functional scores (very low-quality evidence) improved more with VP plus chemotherapy than with chemotherapy alone. KP seemed to lead to significantly greater improvement in pain, disability, and health-related quality of life (HRQoL) compared with nonsurgical management. VP plus Iodine-125 seemed to lead to significantly greater improvement in pain and disability in comparison with VP alone. VP plus radio chemotherapy resulted in better pain relief and HRQoL postoperatively in comparison with routine radio chemotherapy. The authors concluded that there was low-quality evidence to prove that surgical treatment significantly decreases pain and improves functional score and HRQoL following MSL in comparison with nonsurgical management. Based on the analysis of currently published trial data, it is unclear whether VP for MSL provides benefits over KP.

Qi et al. (2016) conducted a meta-analysis to evaluate the function of percutaneous vertebroplasty (PVP) treatment to pain relief and life quality for patients with spinal tumors. Twenty-six studies involving 1,351 patients met selection criteria. Meta-analysis results among 10 case-control studies showed that the combined hazard ratio was -2.83 [95% confidence interval (CI) -2.92, -2.73; $P < .0001$], indicating a 2.83-fold decrease of pain in PVP group. For 12 single-arm studies, a significantly decrease of pain after PVP treatment (HR = -4.79, 95% CI -5.00, -4.57, $P < .0001$) was also found in PVP group. In addition, for KPS analysis, the combined HR was 16.31 (95% CI 14.31, 18.31; $P < .0001$), which indicated that PVP treatment was associated with a 16.31-fold increase of KPS. The combined hazard ratio was 0.58 (95% CI 0.35, 0.96; $P = .04$) for complication analysis. The authors concluded that PVP treatment of spinal tumor is significantly associated with better pain relief and life quality, which could improve the outcome in metastatic spinal tumor patients.

Multiple Myeloma Involving a Vertebral Body

In a systematic review, Health Quality Ontario (2016) evaluated the effectiveness and safety of percutaneous image-guided vertebral augmentation techniques, vertebroplasty and KP, for palliation of cancer-related vertebral compression fractures. Owing to the heterogeneity of the clinical reports, the authors performed a narrative synthesis based on an analytical framework constructed for the type of cancer-related vertebral fractures and the diversity of the vertebral augmentation interventions. One hundred and eleven clinical reports (4,235 patients) were evaluated to determine the effectiveness of vertebroplasty (78 reports, 2,545 patients) or KP (33 reports, 1,690 patients) for patients with mixed primary spinal metastatic cancers, multiple myeloma, or hemangiomas. Overall, the mean pain intensity scores often reported within 48 hours of vertebral augmentation (kyphoplasty or vertebroplasty), were significantly reduced. Analgesic use, although variably reported, usually involved parallel decreases, particularly in opioids, and mean pain-related disability scores were also significantly improved. In a randomized controlled trial comparing KP with usual care, improvements in pain scores, pain-related disability, and health-related quality of life were significantly better in the kyphoplasty group than in the usual care group. Bone cement leakage, mostly asymptomatic, was commonly reported after vertebroplasty and KP. Major adverse events, however, were uncommon. The authors concluded that both vertebroplasty and KP significantly and rapidly reduced pain intensity in cancer patients with vertebral compression fractures. The procedures also significantly decreased the need for opioid pain medication, and functional disabilities related to back and neck pain. Pain palliative improvements and low complication rates were consistent across the various cancer populations and vertebral fractures that were investigated.

In a retrospective observational study, Burton et al. (2011) evaluated outcomes of cancer patients with painful vertebral compression fractures treated with either PVP or KP. A total of 407 cancer patients had 1,156 fractures that had been treated with PVP or KP; the majority of patients had pathological fractures due to multiple myeloma, or osteoporotic fractures. The authors reported that surgery provided significant relief from pain and several related symptoms. Surgery provided significant relief from pain and several related symptoms. Symptomatic, serious complications requiring open surgery occurred in two

cases (< 0.01%). The authors concluded that the use of VP or KP in treating painful VCFs in cancer patients has good efficacy and an acceptably low complication rate. The findings are limited by lack of comparison group without surgical intervention and the observational design of the study.

Vertebral Hemangioma with Aggressive Features

Nambiar et al. (2020) conducted a retrospective multi-center cohort study to evaluate PVP for the treatment of symptomatic vertebral hemangioma. The study included 50 patients with painful vertebral hemangiomas and treated with PVP by a single provider over a 14-year period (March 1999 to April 2013). There was a minimum one-year follow-up. Two patients had recurrent symptoms and repeat vertebroplasty. Pre-intervention VAS score was 7.0 and mean post-intervention VAS at one year was 0.3. The mean reduction in VAS score was 6.8 points. All patients experienced pain relief following PVP, with 39 cases (74%) reporting complete pain relief. There were no cases of symptomatic cement leak, and no cases of procedural morbidity or mortality. The authors concluded that PVP is a safe and effective treatment of symptomatic vertebral hemangioma with low risk of complication.

In a case series of surgical treatments for aggressive vertebral hemangiomas, Vasudeva et al. (2016) report on five patients who underwent surgery for treatment of aggressive vertebral hemangiomas during the specified time period. Intraoperative vertebroplasty was used in three cases to augment the anterior column or to obliterate residual tumor. The authors conclude that despite the variety of available treatment options, the optimal management strategy is unclear because aggressive vertebral hemangiomas are uncommon lesions, making it difficult to perform large trials. In their opinion, vertebroplasty provides hemostatic embolization and improves the load-bearing capacity of the anterior column; however, either kyphoplasty or vertebroplasty may also be used intraoperatively in conjunction with decompressive surgery.

Narayana et al. (2014) evaluated percutaneous vertebroplasty (PVP) in the treatment of painful vertebral hemangiomas refractory to medical management. In this case series, fourteen patients (four thoracic and ten lumbar vertebra) with painful vertebral hemangiomas presenting with severe back pain for more than 6 months not responding to medical therapy were treated by PVP. Cross sectional imaging of the spine with magnetic resonance was done. The pain intensity numeric rating scale (PI-NRS-11) of these patients was in the range of 7-10 (Severe Pain). After vertebroplasty eight patients were completely free of pain (PI NRS Score 0) while six were significantly relieved (PI-NRS Score 1-3). No complications were observed. Two patients with associated radicular pain had good pain relief following PVP. No recurrence was found during 36 months of postoperative follow-up. The authors concluded that PVP is a safe and effective procedure in patients with painful vertebral hemangiomas refractory to medical management. The findings are however limited by lack of comparison group.

Boschi et al. (2012) studied in this case series treatment with vertebroplasty in patients with painful vertebral hemangiomas to determine its validity for this usage. Patients (n = 24) were treated by percutaneous vertebroplasty: 16 thoracic, eight lumbar. The average age at the time of surgery was 48 years. All the patients complained of a pain syndrome resistant to continuing medication. Pre-procedure imaging was conducted for confirmation. The mean follow-up was 5.8 years. In all the patients, the authors observed a successful outcome with a complete resolution of pain symptom. Clinical and radiological follow-up showed stability of the treatment and absence of pain in all patients. They concluded that percutaneous treatment with vertebroplasty for symptomatic vertebral hemangiomas is a valuable, less-invasive, and a quick method that allows a complete and enduring resolution of the painful vertebral symptoms without findings of the vertebral body's fracture. The findings are, however, limited by the lack of comparison group.

Unstable Fractures Due to Osteonecrosis (e.g., Kümmell's Disease)

Dai et al. (2021) performed a prospective study to compare the safety and efficacy of percutaneous vertebroplasty (PVP) versus percutaneous kyphoplasty (PKP) as treatment for osteoporotic Kümmell's disease. The study included 64 patients: 30 patients in the PVP group and 34 patients in the PKP group. Patients were followed for 24 months. Statistical results were insignificant with visual analogue scale (VAS) and Oswestry disability index (ODI) scores showing comparative results (P > 0.05) among PVP and PKP groups at all postoperative time points. The authors concluded that both PVP and PKP are safe and efficient procedures for eliminating pain and achieving kyphosis correction in the treatment of osteoporotic Kümmell's disease. The volume of bone cement injection, intraoperative blood loss, occurrence of bone cement leakage, transient fever, and re-fracture between two groups showed no significant difference. The surgical time, the operation cost and fluoroscopy times of the PKP group was significantly higher than that of the PVP group. The post-operative VAS, ODI scores, the height of the anterior edge of the injured vertebrae and kyphosis deformity were significantly improved in both groups compared with the pre-operation. The improvement of vertebral height and kyphosis deformity in PKP group was significantly better than that in the PVP group at

every same time point during the follow-up periods, but the VAS and ODI scores between the two groups showed no significant difference. The authors concluded that PVP and PKP can both significantly alleviate the pain of patients with KD and obtain good clinical efficacy and safety. By contrast, PKP can achieve better imaging height and kyphosis correction, while PVP has the advantages of shorter operation time, less radiation volume and operation cost.

Zhang et al. (2021) performed a systematic review and meta-analysis to compare clinical outcomes and efficacy of PVP with those of PKP for treatment of neurologically intact osteoporotic Kümmell's disease. The study included eight non-randomized observational studies; two prospective and five retrospective case-control studies. Four hundred thirty-eight patients were included with 195 patients treated with PKP and 243 patients treated with PVP. There were no statistically significant differences in the short-term and long-term VAS and ODI scores between the two groups. PKP provided better short-term and long-term kyphosis correction than did PVP. There were no differences in most of the vertebral height measurements, except for greater restoration of short-term anterior vertebral height and long-term middle vertebral height for the PKP group. The authors concluded that both PVP and PKP are safe and effective treatment options for treatment of neurologically intact Kümmell's disease with comparable clinical outcomes including improved functional status, quality of life, and pain relief.

Chang et al. (2020) performed a prospective study to compare clinical outcomes of percutaneous vertebroplasty (PVP) and percutaneous kyphoplasty (PKP) for Kümmell's disease. The study included 56 patients: 28 patients received PVP, and 28 patients received PKP treatment. Visual analogue scale (VAS) was used to evaluate degree of low back pain and the ODI to evaluate the severity of dysfunction. At two years post-surgery, VAS scores decreased from 8.0 ± 0.77 to 2.5 ± 0.70 in the PVP group, and from 8.0 ± 0.75 to 2.5 ± 0.84 in the PKP group. ODI scores decreased from 84.5 ± 5.94 to 29.9 ± 7.11 in the PVP group, and from 84.9 ± 8.23 to 31.0 ± 7.56 in the PKP group. The authors concluded that PVP and PKP are effective treatment options in Kümmell's disease, as both treatments achieve similar results. Follow-up time, incidence of bone cement leakage, refracture rate of adjacent vertebra and intraoperative amount of bone cement injection between the two groups was not statistically different. Both groups significantly relieved patients' pain of low-back, recovered the height of vertebral body and kyphosis angle and improved their quality of life, but PVP was associated with less surgical time, blood loss, and radiation exposure than those of PKP.

Clinical Practice Guidelines

American Academy of Family Physicians (AAFP)

A 2016 AAFP Practice Management for vertebral compression fractures lists the following clinical recommendations:

- A trial of conservative therapy should be offered to patients with vertebral compression fractures
- Percutaneous vertebral augmentation can be considered in patients who have inadequate pain relief with nonsurgical care or when persistent pain substantially affects quality of life
- Patients with vertebral compression fractures should be evaluated for osteoporosis, and preventive therapy should be initiated if necessary (McCarthy and Davis, 2016)

American Academy of Orthopaedic Surgeons (AAOS)

In its 2010 guidance and evidence report on the treatment of symptomatic osteoporotic spinal compression fractures, the AAOS recommends against vertebroplasty for patients who present with an osteoporotic spinal compression fracture on imaging with correlating clinical signs and symptoms and who are neurologically intact. This recommendation is based on strong evidence regarding Level II studies that compare vertebroplasty to a sham procedure in which there was no statistically significant difference between the two procedures in pain using the VAS and function using the Roland Morris Disability scale (up to one month and six months respectively).

In the same 2010 guidance and evidence report, the AAOS considers kyphoplasty as an option for patients who present with an osteoporotic spinal compression fracture on imaging with correlating clinical signs and symptoms and who are neurologically intact. This is based on limited evidence regarding two Level II studies that examined the use of kyphoplasty compared to conservative treatment. In the study of patients with subacute fractures, clinically important benefits in pain were found at 1 week and 1 month, with possibly important effects at 3 and 6 months. There was no clinically important benefit in pain at 12 months. The study also found possibly clinically important benefits in physical function (at 1 and 3 months only) and the SF-36 physical component score (at 1, 3, and 6 months only). Clinically important improvement in quality of life was present at 1 month, and it was possibly clinically important at 3, 6, and 12 months (AAOS, 2010).

American Association of Clinical Endocrinologists (AACE), and American College of Endocrinology (ACE)

In a clinical practice guideline for the diagnosis and treatment of post-menopausal osteoporosis, the AACE and ACE (Camacho et al., 2016) do not recommended vertebroplasty and kyphoplasty as first-line treatment of vertebral fractures given the unclear benefit on overall pain and the potential increased risk of vertebral fractures in adjacent vertebrae (Grade B, BEL 1; downgraded due to limitations of published studies).

American Association of Neurological Surgeons (AANS)

In a patient guideline on vertebral compression fracture (VCF), the AANS recommended that patients with the following criteria may be considered candidates for vertebroplasty or kyphoplasty:

- Osteoporotic VCFs in any area of the spine that have been present for more than two weeks, causing moderate to severe pain and unresponsive to conservative therapy
- Painful metastases and multiple myelomas
- Painful vertebral hemangiomas (benign, malformed vascular tumors composed of newly formed blood vessels)
- Vertebral osteonecrosis (a condition resulting from poor blood supply to an area of bone, which causes bone death)
- Reinforcement of a pathologically weak vertebral body before a surgical stabilization procedure

Patients with any of the following criteria should not undergo these procedures:

- A VCF that is completely healed or is responding effectively to conservative therapy
- A VCF that has been present for more than one year
- Greater than 80-90% collapse of the vertebral body
- Spinal curvature, such as scoliosis or kyphosis, that is due to causes other than osteoporosis
- Spinal stenosis or herniated discs with nerve or spinal cord compression and loss of neurological function not associated with a VCF
- Untreated coagulopathy (a disease or condition affecting the blood's ability to coagulate)
- Osteomyelitis (an inflammation of the bone and bone marrow, usually caused by bacterial infection)
- Discitis (nonbacterial inflammation of an intervertebral disc or disc space)
- Significant compromise of the spinal canal caused by impeding bone fragment or tumor (AANS, 2021)

American College of Radiology (ACR)

The ACR appropriateness criteria for the management of vertebral compression fractures (2018) notes that conservative management (medical management with or without methods of immobility) is the initial first-line treatment of painful vertebral compression fractures. The ACR defines failure of conservative therapy as pain refractory to oral medications (NSAIDs and/or narcotics) or a contraindication to such medications or a requirement for parenteral narcotics and hospital admission. The ACR observes that the ideal preprocedural imaging has not been identified. The following variants were noted:

Percutaneous vertebral augmentation may be appropriate for the following:

- Asymptomatic pathologic spinal fracture with or without edema on MRI
- New symptomatic compression fracture identified on radiographs or CT. No known malignancy

Percutaneous vertebral augmentation is usually appropriate for the following:

- Osteoporotic compression fracture, with or without edema on MRI and no "red flags," with or without spinal deformity, worsening symptoms, or pulmonary dysfunction
- Pathologic spinal fracture with severe and worsening pain
- Pathologic spinal fracture with spinal deformity or pulmonary dysfunction (ACR, 2018)

American College of Radiology (ACR), American Society of Neuroradiology (ASNR), American Society of Spine Radiology (ASSR), Society of Interventional Radiology (SIR), Society of NeuroInterventional Surgery (SNIS)

The ACR, ASNR, ASSR, SIR and SNIS 2017 practice parameter for the performance of vertebral augmentation states that the major indication for vertebral augmentation is the treatment of symptomatic osteoporotic vertebral body fracture(s) refractory to medical therapy or vertebral bodies weakened due to neoplasia. They comment that although most fractures heal within a few

weeks or months, a minority of patients continue to suffer pain that does not respond to conservative therapy. They note that there is no indication for the use of vertebral augmentation for prophylaxis against future fracture.

International Society for the Advancement of Spine Surgery (ISASS)

The ISASS 2019 policy statement on vertebral augmentation states that vertebral augmentation procedures (vertebroplasty and kyphoplasty) are safe and effective procedures. The level 1 evidence is in favor of vertebral augmentation when compared to conservative management. Failure to treat patients with painful VCFs has been associated with an increased mortality and morbidity. ISASS endorses the early treatment of painful VCFs with vertebral augmentation procedures (vertebroplasty and preferentially kyphoplasty) [Clerk-Lamallice et al. (2019)].

The National Institute for Health and Care Excellence (NICE)

A NICE 2013 (reviewed and confirmed 2016) technology guidance appraisal, on percutaneous vertebroplasty and percutaneous balloon kyphoplasty for treating osteoporotic vertebral compression fractures, recommends percutaneous vertebroplasty, and percutaneous balloon kyphoplasty without stenting, as options for treating osteoporotic vertebral compression fractures only in people who:

- Have severe ongoing pain after a recent, unhealed vertebral fracture despite optimal pain management, and
- In whom the pain has been confirmed to be at the level of the fracture by physical examination and imaging.

Society of Interventional Radiology (SIR), American Association of Neurological Surgeons (AANS) and the Congress of Neurological Surgeons (CNS), American College of Radiology (ACR), American Society of Neuroradiology (ASNR), American Society of Spine Radiology (ASSR), Canadian Interventional Radiology Association (CIRA), and Society of NeuroInterventional Surgery (SNIS)

The 2014 SIR, AANS, CNS, ACR, ASNR, ASSR, CIRA and the SNIS consensus statement on percutaneous vertebral augmentation states that percutaneous vertebral augmentation with the use of vertebroplasty or kyphoplasty is a safe, efficacious, and durable procedure in appropriate patients with symptomatic osteoporotic and neoplastic fractures when performed in a manner in accordance with published standards. They further comment that these procedures are offered only when non-operative medical therapy has not provided adequate pain relief or pain is significantly altering the patient's quality of life.

Currently, there is no indication for the use of vertebral augmentation for prophylaxis against future fracture. The indications and contraindications for vertebral augmentation may change in the future, as more research and information become available (Barr, 2017).

Society of NeuroInterventional Surgery (SNIS)

In a 2014 report, the Standards and Guidelines Committee of the Society of NeuroInterventional Surgery on vertebral augmentation concluded that:

- Kyphoplasty in selected patients is superior to conservative medical therapy in reducing back pain, disability and improving Karnofsky performance status and quality of life for patients with cancer and disabling back pain from a vertebral fracture (AHA Class IIA, Level of Evidence B).
- Vertebroplasty and kyphoplasty are reasonable therapeutic options in selected patients with cancer and severe back pain from a vertebral fracture that is refractory to conservative medical therapy (AHA Class IIA, Level of Evidence B).
- Vertebroplasty and kyphoplasty are reasonable therapeutic options in selected patients with severe back pain from an osteoporotic vertebral fracture that is refractory to conservative medical therapy (AHA Class IIA, Level of Evidence B).

U.S. Food and Drug Administration (FDA)

This section is to be used for informational purposes only. FDA approval alone is not a basis for coverage.

Percutaneous vertebroplasty and kyphoplasty are procedures and not regulated by the FDA.

A number of bone cement products have been approved for marketing by the FDA as Class II devices. Refer to the following website for more information (use product codes NDN, LOD):

<http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm> (Accessed September 13, 2021)

Polymethylmethacrylate (PMMA) bone cement is a device intended to be implanted that is made from methyl methacrylate, polymethylmethacrylate, esters of methacrylic acid, or copolymers containing polymethylmethacrylate and polystyrene. These bone cement products are intended for use in arthroplastic procedures of the hip, knee, and other joints for the fixation of polymer or metallic prosthetic implants to living bone.

The FDA has approved bone tamps for the creation of a void in cancellous bone in the spine (including use during a balloon kyphoplasty procedure with a PMMA-based bone cement that is cleared for use in kyphoplasty procedures). Bone tamps are categorized by the FDA as Class II devices. Refer to the following website for more information (use product codes HRX, HXG): <http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm> (Accessed September 13, 2021)

References

American Academy of Orthopaedic Surgeons (AAOS). The treatment of symptomatic osteoporotic spinal compression fractures. Guideline and evidence report. 2010.

American Association of Neurological Surgeons. Vertebral Compression Fractures.

<https://www.aans.org/en/Patients/Neurosurgical-Conditions-and-Treatments/Vertebral-Compression-Fractures>. Accessed September 13, 2021.

American College of Radiology (ACR). ACR appropriateness criteria. Management of vertebral compression fractures. 2013. Revised 2018.

American College of Radiology (ACR), American Society of Neuroradiology (ASNR), American Society of Spine Radiology (ASSR), Society of Interventional Radiology (SIR), Society of NeuroInterventional Surgery (SNIS). Practice parameter for the performance of vertebral augmentation. Revised 2017. Amended 2019. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/vertebraaug.pdf>. Accessed September 23, 2021.

Anselmetti GC, Manca A, Montemurro F, et al. Percutaneous vertebroplasty in multiple myeloma: prospective long-term follow-up in 106 consecutive patients. *Cardiovasc Intervent Radiol*. 2012 Feb;35(1):139-45.

Astur N, Avanzi O. Balloon kyphoplasty in the treatment of neoplastic spine lesions: A systematic review. *Global Spine J*. 2019 May;9(3):348-356.

Barr JD, Jensen ME, Hirsch JA, et al. Position statement on percutaneous vertebral augmentation: a consensus statement developed by the Society of Interventional Radiology (SIR), American Association of Neurological Surgeons (AANS) and the Congress of Neurological Surgeons (CNS), American College of Radiology (ACR), American Society of Neuroradiology (ASNR), American Society of Spine Radiology (ASSR), Canadian Interventional Radiology Association (CIRA), and the Society of NeuroInterventional Surgery (SNIS). *J Vasc Interv Radiol*. 2014; 25(2):171-181. Reaffirmed 2017.

Berenson J, Pflugmacher R, Jarzem P, et al. Balloon kyphoplasty versus non-surgical fracture management for treatment of painful vertebral body compression fractures in patients with cancer: a multicentre, randomised controlled trial. *Lancet Oncol*. 2011 Mar;12(3):225-35.

Blasco J, Martinez-Ferrer A, Macho J, et al. Effect of vertebroplasty on pain relief, quality of life, and the incidence of new vertebral fractures: a 12-month randomized follow-up, controlled trial. *J Bone Miner Res*. 2012 May;27(5):1159-66.

Boonen S, Van Meirhaeghe J, Bastian L, et al. Balloon kyphoplasty for the treatment of acute vertebral compression fractures: 2-year results from a randomized trial. *J Bone Miner Res*. 2011 Jul;26(7):1627-37.

Boschi V, Pogorelić Z, Gulan G, et al. Management of cement vertebroplasty in the treatment of vertebral hemangioma. *Scand J Surg*. 2011;100(2):120-4.

Buchbinder R, Golmohammadi K, Johnston RV, et al. Percutaneous vertebroplasty for osteoporotic vertebral compression fracture. *Cochrane Database Syst Rev*. 2015 Apr 30;4:CD006349.

Buchbinder R, Johnston RV, Rischin KJ, et al. Percutaneous vertebroplasty for osteoporotic vertebral compression fracture. *Cochrane Database Syst Rev*. 2018 Apr 4;4:CD006349.

Burton AW, Mendoza T, Gebhardt R, et al. Vertebral compression fracture treatment with vertebroplasty and kyphoplasty: experience in 407 patients with 1,156 fractures in a tertiary cancer center. *Pain Med.* 2011 Dec;12(12):1750-7.

Camacho PM, Petak SM, Binkley N, et al. American Association of Clinical Endocrinologists and American College of Endocrinology clinical practice guidelines for the diagnosis and treatment of postmenopausal osteoporosis – 2016. *Endocr Pract.* 2016 Sep 2;22(Suppl 4):1-42.

Chang JZ, Bei MJ, Shu DP, et al. Comparison of the clinical outcomes of percutaneous vertebroplasty vs. kyphoplasty for the treatment of osteoporotic Kümmell's disease: a prospective cohort study. *BMC Musculoskelet Disord.* 2020 Apr 13;21(1):238.

Chen D, An ZQ, Song S, et al. Percutaneous vertebroplasty compared with conservative treatment in patients with chronic painful osteoporotic spinal fractures. *J Clin Neurosci.* 2014 Mar;21(3):473-7.

Clerk-Lamallice O, Beall D, Ong, and Lorio Km. Vertebral augmentation: coverage indications, limitations, and/or medical necessity. International Society for the Advancement of Spine Surgery (ISASS). Policy Statement. February 13, 2019.

Dai SQ, Qin RQ, Shi X, et al. Percutaneous vertebroplasty versus kyphoplasty for the treatment of neurologically intact osteoporotic Kümmell's disease. *BMC Surg.* 2021 Jan 29;21(1):65.

Evans AJ, Kip KE, Brinjikji W, et al. Randomized controlled trial of vertebroplasty versus kyphoplasty in the treatment of vertebral compression fractures. *Neurointerv Surg.* 2016 Jul;8(7):756-63.

Farrokhi MR, Alibai E, Maghami Z. Randomized controlled trial of percutaneous vertebroplasty versus optimal medical management for the relief of pain and disability in acute osteoporotic vertebral compression fractures. *J Neurosurg Spine.* 2011 May;14(5):561-9.

Farrokhi M, Nouraei H, and Kiani A. The efficacy of percutaneous vertebroplasty in pain relief in patients with pathological vertebral fractures due to metastatic spinal tumors. *Iran Red Crescent Med J.* 2012 Sep; 14(9): 523-530.

Firanesco CE, de Vries J, Lodder P, et al. Vertebroplasty versus sham procedure for painful acute osteoporotic vertebral compression fractures (VERTOS IV): randomised sham controlled clinical trial. *BMJ.* 2018 May 9;361:k1551.

Gu CN, Brinjikji W, Evans AJ, et al. Outcomes of vertebroplasty compared with kyphoplasty: a systematic review and meta-analysis. *J Neurointerv Surg.* 2016 Jun;8(6):636-42.

Hayes, Inc. Hayes Medical Technology Directory Report. Comparative effectiveness of percutaneous vertebroplasty versus sham, conservative treatment, or kyphoplasty for osteoporotic vertebral compression fractures. Lansdale, PA: Hayes, Inc.; December 2016. Updated May 5, 2021.

Hayes, Inc. Hayes Medical Technology Directory Report. Percutaneous kyphoplasty for osteoporotic vertebral compression fractures. Lansdale, PA: Hayes, Inc.; March 2017. Updated April 29, 2021.

Health Quality Ontario. Vertebral augmentation involving vertebroplasty or kyphoplasty for cancer-related vertebral compression fractures: a systematic review. *Ont Health Technol Assess Ser.* 2016 May 1;16(11):1-202.

Hinde K, Maingard J, Hirsch JA, et al. Mortality outcomes of vertebral augmentation (vertebroplasty and/or balloon kyphoplasty) for osteoporotic vertebral compression fractures: a systematic review and meta-analysis. *Radiology.* 2020 Apr;295(1):96-103.

Kallmes DF, Comstock BA, Heagerty PJ, et al. A randomized controlled trial of vertebroplasty for osteoporotic spine fractures. *N Engl J Med.* 2009 Aug 6; 361(6): 569-579.

Klazen C, Lohle P, de Vries J, et al. Vertebroplasty versus conservative treatment in acute osteoporotic vertebral compression fractures (Vertos II): an open-label randomised trial. *Lancet* Volume 376, No. 9746, p1,085-1,092, 25 September 2010.

Li WS, Cai YF, Cong L. The effect of vertebral augmentation procedure on painful OVCFs: a meta-analysis of randomized controlled trials. *Global Spine J.* 2021 Mar 11:2192568221999369.

Liu J, Li X, Tang D, et al. Comparing pain reduction following vertebroplasty and conservative treatment for osteoporotic vertebral compression fractures: a meta-analysis of randomized controlled trials. *Pain Physician.* 2013 Sep-Oct;16(5):455-64.

Liu Q, Cao J, Kong JJ. Clinical effect of balloon kyphoplasty in elderly patients with multiple osteoporotic vertebral fractures. *Niger J Clin Pract.* 2019 Mar;22(3):289-292.

Mattie R, Laimi K, Yu S, et al. Comparing percutaneous vertebroplasty and conservative therapy for treating osteoporotic compression fractures in the thoracic and lumbar spine: a systematic review and meta-analysis. *J Bone Joint Surg Am.* 2016 Jun 15;98(12):1041-51.

McCarthy J and Davis A. Diagnosis and management of vertebral compression fractures. *Am Fam Physician*. 2016 Jul 1;94(1):44-50.

Nambiar M, Maingard JT, Onggo JR, et al. Single level percutaneous vertebroplasty for vertebral hemangiomas – a review of outcomes. *Pain Physician*. 2020 Nov;23(6):E637-E642.

Narayana RV, Pati R, Dalai S. Percutaneous vertebroplasty in painful refractory vertebral hemangiomas. *Indian J Orthop*. 2014 Mar-Apr; 48(2): 163-167.

National Institute for Health and Care Excellence (NICE). NICE technology appraisal guidance [TA279]. Percutaneous vertebroplasty and percutaneous balloon kyphoplasty for treating osteoporotic vertebral compression fractures. April 2013. Reviewed and confirmed January 2016.

National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMSD). National Institute of Health (NIH). Osteonecrosis. November 2014.

Noriega DC, Rodriguez-Monsalve F, Ramajo R, et al. Long-term safety and clinical performance of kyphoplasty and SpineJack® procedures in the treatment of osteoporotic vertebral compression fractures: a pilot, monocentric, investigator-initiated study. *Osteoporos Int*. 2019 Mar;30(3):637-645.

Pourtaheri S, Luo W, Cui C, Garfin S. Vertebral augmentation is superior to nonoperative care at reducing lower back pain for symptomatic osteoporotic compression fractures: a meta-analysis. *Clin Spine Surg*. 2018 Oct;31(8):339-344.

Qi L, Li C, Wang N, et al. Efficacy of percutaneous vertebroplasty treatment of spinal tumors: a meta-analysis. *Medicine (Baltimore)*. 2018 Jan;97(3):e9575.

Rodriguez AJ, Fink HA, Mirigian L, et al. Pain, quality of life and safety outcomes of kyphoplasty for vertebral compression fractures: report of a task force of the American Society for Bone and Mineral Research. *J Bone Miner Res*. 2017 Sep;32(9):1935-1944.

Sadeghi-Naini M, Aarabi S, Shokrane F, et al. Vertebroplasty and kyphoplasty for metastatic spinal lesions: a systematic review. *Clin Spine Surg*. 2018 Jun;31(5):203-210.

Schrock WB, Wetzel RJ, Tanner, SC, et al. Aggressive hemangioma of the thoracic spine. *J Radiol Case Rep*. 2011; 5(10): 7-13.

Shi MM, Cai XZ, Lin T. et al. Is there really no benefit of vertebroplasty for osteoporotic vertebral fractures? A meta-analysis. *Clin Orthop Relat Res*. 2012 Oct; 470(10): 2785–2799.

Sorensen ST, Kirkegaard AO, Carreon L, et al. Vertebroplasty or kyphoplasty as palliative treatment for cancer-related vertebral compression fractures: a systematic review. *Spine J*. 2019 Jun;19(6):1067-1075.

Stevenson M, Gomersall T, Lloyd Jones M, et al. Percutaneous vertebroplasty and percutaneous balloon kyphoplasty for the treatment of osteoporotic vertebral fractures: a systematic review and cost-effectiveness analysis. *Health Technol Assess*. 2014 Mar;18(17):1-290.

Sun G, Li L, Jin P, et al. Percutaneous vertebroplasty for painful spinal metastasis with epidural encroachment. *J Surg Oncol*. 2014 Aug;110(2):123-8.

Tan HY, Wang LM, Zhao L, et al. A prospective study of percutaneous vertebroplasty for chronic painful osteoporotic vertebral compression fracture. *Pain Res Manag*. 2015 Jan-Feb;20(1):e8-e11.

Vasudeva VS, Chi JH, Groff MW. Surgical treatment of aggressive vertebral hemangiomas. *Neurosurg Focus* 41 (2):E7, 2016.

Wang B, Guo H, Yuan L et al. A prospective randomized controlled study comparing the pain relief in patients with osteoporotic vertebral compression fractures with the use of vertebroplasty or facet blocking. *Eur Spine J*. 2016 Nov;25(11):3486-3494.

Wang B, Zhao CP, Song LX, Zhu L. Balloon kyphoplasty versus percutaneous vertebroplasty for osteoporotic vertebral compression fracture: a meta-analysis and systematic review. *J Orthop Surg Res*. 2018 Oct 22;13(1):264.

Wei H, Dong C, Zhu Y, et al. Analysis of two minimally invasive procedures for osteoporotic vertebral compression fractures with intravertebral cleft: a systematic review and meta-analysis. *J Orthop Surg Res*. 2020 Sep 10;15(1):401.

Xie L, Zhao ZG, Zhang SJ, et al. Percutaneous vertebroplasty versus conservative treatment for osteoporotic vertebral compression fractures: an updated meta-analysis of prospective randomized controlled trials. *Int J Surg*. Nov 2017;47:25-32.

Yuan WH, Hsu CH, Lai LK. Vertebroplasty and balloon kyphoplasty versus conservative treatment for osteoporotic vertebral compression fractures. A meta-analysis. *Medicine (Baltimore)*. 2016 Aug;95(31):e4491.

Zhang B, Chen G, Yang X, et al. Percutaneous kyphoplasty versus percutaneous vertebroplasty for neurologically intact osteoporotic Kümmell's disease: a systematic review and meta-analysis. *Global Spine J.* 2021 Feb 5;2192568220984129.

Zhang GQ, Gao YZ, Chen SL, et al. Comparison of percutaneous vertebroplasty and percutaneous kyphoplasty for the management of Kümmell's disease: A retrospective study. *Indian J Orthop.* 2015 Nov-Dec; 49(6): 577-582.

Zhang H, Xu C, Zhang T, et al. Does percutaneous vertebroplasty or balloon kyphoplasty for osteoporotic vertebral compression fractures increase the incidence of new vertebral fractures? A meta-analysis. *Pain Physician.* 2017 Jan-Feb;20(1):E13-E28.

Zhao S, Xu CY, Zhu AR, et al. Comparison of the efficacy and safety of 3 treatments for patients with osteoporotic vertebral compression fractures: a network meta-analysis. *Medicine (Baltimore).* 2017 Jun;96(26):e7328.

Zuo XH, Zhu XP, Bao HG, et al. Network meta-analysis of percutaneous vertebroplasty, percutaneous kyphoplasty, nerve block, and conservative treatment for non-surgery options of acute/subacute and chronic osteoporotic vertebral compression fractures (OVCFs) in short-term and long-term effects. *Medicine (Baltimore).* 2018 Jul;97(29):e11544.

Policy History/Revision Information

Date	Summary of Changes
08/01/2022	Application <ul style="list-style-type: none">Added reference link to the state-specific Medical Policy titled <i>Percutaneous Vertebroplasty and Kyphoplasty (for New Jersey Only)</i>
07/01/2022	Application <i>Mississippi, Nebraska, and North Carolina</i> <ul style="list-style-type: none">Updated language to indicate this Medical Policy applies to the states of Mississippi, Nebraska, and North Carolina (retired state-specific policy versions) Supporting Information <ul style="list-style-type: none">Archived previous policy version CS330.A

Instructions for Use

This Medical Policy provides assistance in interpreting UnitedHealthcare standard benefit plans. When deciding coverage, the federal, state or contractual requirements for benefit plan coverage must be referenced as the terms of the federal, state or contractual requirements for benefit plan coverage may differ from the standard benefit plan. In the event of a conflict, the federal, state or contractual requirements for benefit plan coverage govern. Before using this policy, please check the federal, state or contractual requirements for benefit plan coverage. UnitedHealthcare reserves the right to modify its Policies and Guidelines as necessary. This Medical Policy is provided for informational purposes. It does not constitute medical advice.

UnitedHealthcare may also use tools developed by third parties, such as the InterQual® criteria, to assist us in administering health benefits. The UnitedHealthcare Medical Policies are intended to be used in connection with the independent professional medical judgment of a qualified health care provider and do not constitute the practice of medicine or medical advice.