Percutaneous Vertebroplasty, Kyphoplasty, Mechanical Vertebral Augmentation and Sacroplasty

Policy # 00094
Original Effective Date: 11/21/2002
Current Effective Date: 05/18/2016

Applies to all products administered or underwritten by Blue Cross and Blue Shield of Louisiana and its subsidiary, HMO Louisiana, Inc. (collectively referred to as the “Company”), unless otherwise provided in the applicable contract. Medical technology is constantly evolving, and we reserve the right to review and update Medical Policy periodically.

Vertebroplasty and Sacroplasty
When Services May Be Eligible for Coverage
Coverage for eligible medical treatments or procedures, drugs, devices or biological products may be provided only if:

- Benefits are available in the member’s contract/certificate, and
- Medical necessity criteria and guidelines are met.

Based on review of available data, the Company may consider percutaneous vertebroplasty for the treatment of symptomatic osteoporotic vertebral fractures that have failed to respond to conservative treatment (e.g., analgesics, physical therapy and rest) for at least 6 weeks to be eligible for coverage.

Based on review of available data, the Company may consider percutaneous vertebroplasty for the treatment of severe pain due to osteolytic lesions of the spine related to multiple myeloma or metastatic malignancies to be eligible for coverage.

When Services Are Considered Investigational
Coverage is not available for investigational medical treatments or procedures, drugs, devices or biological products.

Based on review of available data, the company considers percutaneous vertebroplasty for all other indications, including use in acute vertebral fractures due to osteoporosis or trauma to be investigational.*

Based on review of available data, the company considers percutaneous sacroplasty for all indications, including use in sacral insufficiency fractures due to osteoporosis and spinal lesions due to metastatic malignancies or multiple myeloma to be investigational.*

Kyphoplasty and Mechanical Vertebral Augmentation
When Services May Be Eligible for Coverage
Coverage for eligible medical treatments or procedures, drugs, devices or biological products may be provided only if:

- Benefits are available in the member’s contract/certificate, and
- Medical necessity criteria and guidelines are met.

Based on review of available data, the Company may consider percutaneous balloon kyphoplasty or mechanical vertebral augmentation with Kiva®‡ for the treatment of symptomatic osteoporotic vertebral fractures that have failed to respond to conservative treatment (e.g., analgesics, physical therapy, rest) for at least 6 weeks to be eligible for coverage.
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Based on review of available data, the Company may consider percutaneous balloon kyphoplasty or mechanical vertebral augmentation with Kiva for the treatment of severe pain due to osteolytic lesions of the spine related to multiple myeloma or metastatic malignancies to be eligible for coverage.

When Services Are Considered Investigational
Coverage is not available for investigational medical treatments or procedures, drugs, devices or biological products.

Based on review of available data, the company considers percutaneous balloon kyphoplasty and mechanical vertebral augmentation with Kiva for all other indications, including use in acute vertebral fractures due to osteoporosis or trauma, to be investigational.*

Based on review of available data, the company considers the use of vertebral body stenting to be investigational.*

Background/Overview
Kyphoplasty and Mechanical Vertebral Augmentation with Kiva

Percutaneous balloon kyphoplasty and mechanical vertebral augmentation with Kiva are interventional techniques involving the fluoroscopically guided injection of polymethylmethacrylate (PMMA) into a cavity created in the vertebral body with a balloon or mechanical device. These techniques have been investigated as an option to provide mechanical support and symptomatic relief in patients with osteoporotic vertebral compression fracture, or in those with osteolytic lesions of the spine, ie, multiple myeloma or metastatic malignancies.

Balloon kyphoplasty is a variant of vertebroplasty and uses a specialized bone tamp with an inflatable balloon to expand a collapsed vertebral body as close as possible to its natural height before injection of the PMMA. Radiofrequency kyphoplasty is a modification of balloon kyphoplasty. In this procedure, an ultra-high viscosity cement is injected into the fractured vertebral body, and radiofrequency is used to achieve the desired consistency of the cement. The ultra-high viscosity cement is designed to restore height and alignment to the fractured vertebra, along with stabilizing the fracture.

It has been proposed that kyphoplasty may provide an analgesic effect through mechanical stabilization of a fractured or otherwise weakened vertebral body. However, other possible mechanisms of effect have been postulated, one of which is thermal damage to intraosseous nerve fibers given that PMMA undergoes a heat-releasing (exothermic) reaction during its hardening process.

Kiva is another mechanical vertebral augmentation technique that uses an implant for structural support of the vertebral body and to provide a reservoir for bone cement. The Kiva VCF (vertebral compression fracture) system consists of a shaped memory coil and Kiva implant, which is filled with bone cement. The coil is inserted into the vertebral body over a removable guide wire. The coil reconfigures itself into a stack of loops within the vertebral body and can be customized by changing the number of loops of the coil. The implant, made from PEEK-OPTIMA®‡, a biocompatible polymer is deployed over the coil. The coil is then retracted and PMMA is injected through the lumen of the implant. The PMMA cement flows through small
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slots in the center of the implant, which fixes the implant to the vertebral body and contains the PMMA in a cylindrical column. The proposed advantage of the Kiva system is a reduction in cement leakage.

Another variant of kyphoplasty is vertebral body stenting, which utilizes an expandable scaffold instead of a balloon to restore vertebral height. The proposed advantages of vertebral body stenting are to reduce the risk of cement leakage by formation of a cavity for cement application and to prevent the loss of correction that is seen following removal of the balloon used for balloon kyphoplasty.

Osteoporotic Vertebral Compression Fracture
Osteoporotic compression fractures are a common problem, and it is estimated that up to one-half of women and approximately one quarter of men will have a vertebral fracture at some point in their lives. However, only about one-third of vertebral fractures actually reach clinical diagnosis, and most symptomatic fractures will heal within a few weeks or 1 month. However, a minority of patients will exhibit chronic pain following osteoporotic compression fracture that presents challenges for medical management. Chronic symptoms do not tend to respond to the management strategies for acute pain such as bedrest, immobilization/bracing device, and analgesic medication, sometimes including narcotic analgesics. The source of chronic pain after vertebral compression fracture may not be from the vertebra itself but may be predominantly related to strain on muscles and ligaments secondary to kyphosis. This type of pain frequently is not improved with analgesics and may be better addressed through exercise.

Vertebral Body Metastasis
Metastatic malignant disease involving the spine generally involves the vertebral bodies, with pain being the most frequent complaint. While radiation and chemotherapy are frequently effective in reducing tumor burden and associated symptoms, pain relief may be delayed days to weeks, depending on tumor response. Further, these approaches rely on bone remodeling to regain vertebral body strength, which may necessitate supportive bracing to minimize the risk of vertebral body collapse during healing.

Vertebral Hemangiomas
Vertebral hemangiomas are relatively common lesions noted in up to 12% of the population based on autopsy series; however, only rarely do these lesions display aggressive features and produce neurologic compromise and/or pain. Treatment of aggressive vertebral hemangiomas has evolved from radiation therapy to surgical approaches using anterior spinal surgery for resection and decompression. There is the potential for large blood loss during surgical resection, and vascular embolization techniques have been used as adjuncts to treatment to reduce blood loss. Percutaneous cementoplasty has been proposed as a way to treat and stabilize some hemangioma to limit the extent of surgical resection and as an adjunct to reduce associated blood loss from the surgery.

Vertebroplasty and Sacroplasty
Percutaneous vertebroplasty is an interventional technique involving the fluoroscopically guided injection of PMMA through a needle inserted into a weakened vertebral body. The technique has been investigated as an option to provide mechanical support and symptomatic relief in patients with osteoporotic vertebral compression fracture or in those with osteolytic lesions of the spine, ie, multiple myeloma or metastatic malignancies. Percutaneous vertebroplasty has also been investigated as an adjunct to surgery for...
aggressive vertebral body hemangiomas, and as a technique to limit blood loss related to surgery. Injection of PMMA is also being investigated for the treatment of sacral insufficiency fractures.

Percutaneous Vertebroplasty
It has been proposed that vertebroplasty may provide an analgesic effect through mechanical stabilization of a fractured or otherwise weakened vertebral body. However, other possible mechanisms of effect have been postulated, including thermal damage to intraosseous nerve fibers, because PMMA undergoes a heat-releasing (exothermic) reaction during its hardening process.

Percutaneous Sacroplasty
Sacroplasty evolved from the treatment of insufficiency fractures in the thoracic and lumbar vertebrae with vertebroplasty. The procedure, essentially identical, entails guided injection of PMMA through a needle inserted into the fracture zone. While first described in 2001 as a treatment for symptomatic sacral metastatic lesions, it is most often described as a minimally invasive procedure employed as an alternative to conservative management for SIFs. SIFs are the consequence of excessive stress on weakened bone and are often the cause of low back pain in the elderly population. Osteoporosis is the most common risk factor for SIF.

Osteoporotic Vertebral Compression Fracture
Osteoporotic compression fractures are a common problem, and it is estimated that up to one-half of women and approximately one-quarter of men will have a vertebral fracture at some point in their lives. However, only about one-third of vertebral fractures actually reach clinical diagnosis, and most symptomatic fractures will heal within a few weeks or 1 month. However, a minority of patients will exhibit chronic pain following osteoporotic compression fracture that presents challenges for medical management. Chronic symptoms do not tend to respond to the management strategies for acute pain such as bed rest, immobilization/bracing device, and analgesic medication, sometimes including narcotic analogesics. The source of chronic pain after vertebral compression fracture may not be from the vertebra itself but may be predominantly related to strain on muscles and ligaments secondary to kyphosis. This type of pain frequently is not improved with analgesics and may be better addressed through exercise.

Sacral Insufficiency Fractures
Spontaneous fracture of the sacrum in patients with osteoporosis was described by Lourie in 1982 and presents as lower back and buttock pain with or without referred pain in the legs. Although common, SIFs can escape detection due to low provider suspicion and poor sensitivity on plain radiographs, slowing the application of appropriate intervention. Similar interventions are used for sacral and vertebral fractures including bed rest, bracing, and analgesics. Initial clinical improvements may occur quickly; however, the resolution of all symptoms may not occur for 9 to 12 months.

Vertebral/Sacral Body Metastasis
Metastatic malignant disease involving the spine generally involves the vertebrae/sacrum, with pain being the most frequent complaint. While radiation and chemotherapy are frequently effective in reducing tumor burden and associated symptoms, pain relief may be delayed days to weeks, depending on tumor
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response. Further, these approaches rely on bone remodeling to regain strength in the vertebrae/sacrum, which may necessitate supportive bracing to minimize the risk of vertebral/sacral collapse during healing.

Vertebral Hemangiomas
Vertebral hemangiomas are relatively common lesions noted in up to 12% of the population based on autopsy series; however, only rarely do these lesions display aggressive features and produce neurologic compromise and/or pain. Treatment of aggressive vertebral hemangiomas has evolved from radiation therapy to surgical approaches using anterior spinal surgery for resection and decompression. There is the potential for large blood loss during surgical resection, and vascular embolization techniques have been used as adjuncts to treatment to reduce blood loss. Percutaneous vertebroplasty has been proposed as a way to treat and stabilize some hemangioma to limit the extent of surgical resection and as an adjunct to reduce associated blood loss from the surgery.

FDA or Other Governmental Regulatory Approval
U.S. Food and Drug Administration
Kyphoplasty
Kyphoplasty is a surgical procedure and, as such, is not subject to U.S. FDA approval. Balloon kyphoplasty requires the use of an inflatable bone tamp. One such tamp, the KyphX™ inflatable bone tamp, received 510(k) marketing clearance from FDA in July 1998. Other devices with FDA 510(k) marketing clearance include AVAmx™ Vertebral Balloon system (Carefusion), NeuroTherm Parallax™ Balloon Inflatable Bone Tamp (NeuroTherm Inc.), Stryker iVAS™ Balloon catheter, and Synthes Synflate™ Vertebral Balloon System, Synthes (USA) LLC (FDA product code NDN).

The Kiva VCF Treatment System (Benvenue Medical) received FDA 510(k) marketing clearance in January 2014 (FDA product code NDN).

Vertebral body stenting (VBS™; Synthes, Switzerland)† is available in Europe at this time.

PMMA bone cement was available as a drug product before enactment of FDA’s device regulation and was at first considered what the FDA terms a “transitional device.” It was transitioned to a class III device requiring premarketing applications. Several orthopedic companies have received approval of their bone cement products since 1976. In October 1999, PMMA was reclassified from class III to class II, which requires future 510(k) submissions to meet “special controls” instead of “general controls” to assure safety and effectiveness.

Thus, use of PMMA in kyphoplasty represented an off-label use of an FDA-regulated product before July 2004. In July 2004, KyphX HV-RTM bone cement was given 510(k) marketing clearance by FDA for the treatment of pathologic fractures of the vertebrae body due to osteoporosis, cancer, or benign lesions using a balloon kyphoplasty procedure. Subsequently, other products such as Spine-Fix™ Biomimetic Bone Cement and Osteopal™ V have been issued 510(k) marketing clearance for the fixation of pathologic fractures of the vertebrae body using vertebroplasty or kyphoplasty procedures.
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FDA also issued a “Public Health Web Notification: Complications related to the use of bone cement in vertebroplasty and kyphoplasty procedures.” This notification is intended to inform the public about reports on safety and to encourage hospitals and other user facilities to report adverse events related to bone cement malfunctions either directly to manufacturers or to MedWatch, FDA’s voluntary reporting program.

**Vertebroplasty and Sacroplasty**

Vertebroplasty is a surgical procedure and, as such, is not subject to U.S. FDA approval. PMMA bone cement was available as a drug product before enactment of FDA’s device regulation and was at first considered what FDA terms a “transitional device.” It was transitioned to a class III device requiring premarketing applications. Several orthopedic companies have received approval of their bone cement products since 1976. In October 1999, PMMA was reclassified from class III to class II, which requires future 510(k) submissions to meet “special controls” instead of “general controls” to assure safety and effectiveness. FDA issued a guidance document on July 17, 2002 (last accessed September 2002, available at: [http://www.fda.gov/cdrh/ode/guidance/668.pdf](http://www.fda.gov/cdrh/ode/guidance/668.pdf)) that outlines the types of special controls required and describes the recommended labeling information.

Thus, use of PMMA in vertebroplasty represented an off-label use of an FDA-regulated product before 2005. In 2005, PMMA bone cements such as Spine-Fix® Biomimetic Bone Cement and Osteopal V were issued 510(k) marketing clearance for the fixation of pathologic fractures of the vertebral body using vertebroplasty or kyphoplasty procedures.

FDA also issued a “Public Health Web Notification: Complications related to the use of bone cement in vertebroplasty and kyphoplasty procedures,” which is available at: [www.fda.gov/cdrh/safety/bonecement.html](http://www.fda.gov/cdrh/safety/bonecement.html). This notification is intended to inform the public about reports on safety and to encourage hospitals and other user facilities to report adverse events related to bone cement malfunctions, either directly to manufacturers or to MedWatch, FDA’s voluntary reporting program.

The use of PMMA in sacroplasty represents an off-label use of an FDA-regulated product (bone cements such as Spine-Fix Biomimetic Bone Cement and Osteopal V), as the 510(k) marketing clearance was for the fixation of pathologic fractures of the vertebral body using vertebroplasty or kyphoplasty procedures. Sacroplasty was not included.

ArthroCare received FDA clearance for the Parallax Contour® Vertebral Augmentation Device in 2010. The device creates a void in cancellous bone that can then be filled with bone cement.

Vesselpasty using Vessel-X®, (MAXXSPINE) and a similar procedure from A-Spine, are variations of vertebroplasty that are reported to eliminate leakage of bone cement by containing the filler in an inflatable vessel. These devices do not have clearance for marketing by FDA.

Centers for Medicare and Medicaid Services (CMS)
There is no national coverage determination (NCD). In the absence of an NCD, coverage decisions are left to the discretion of local Medicare carriers.
Rationale/Source

Kyphoplasty

For treatment of osteoporosis and malignancy with percutaneous kyphoplasty, the primary beneficial outcomes of interest are relief of pain and improvement in ability to function. Kyphoplasty may also result in restoration of lost vertebral body height with associated reduction in kyphotic deformity. Potential health outcomes related to kyphotic deformity include pulmonary or gastrointestinal compression and associated symptoms, and vertebral compression fractures may be associated with lower health-related quality of life. Ex vivo cadaver studies reporting bone strength as a surrogate outcome measure have been reported but are not included in this evaluation of health outcomes.

Pain and functional ability are subjective outcomes and, thus, may be susceptible to placebo effects. Furthermore, the natural history of pain and disability associated with these conditions may be variable. Therefore, controlled comparison studies would be valuable to demonstrate the clinical effectiveness of kyphoplasty over and above any associated nonspecific or placebo effects and to demonstrate the effect of treatment compared with an alternative such as continued medical management.

In all clinical situations, adverse effects related to complications from kyphoplasty are the primary harms to be considered. Principal safety concerns relate to the incidence and consequences of leakage of the injected PMMA.

Originally the available data were observational. Evidence from observational studies were generally consistent in showing significant decreases in pain from an initial preoperative level of 7 to 9 on a visual analog scale (VAS) or similar score proportionate to the highest possible score) to 2 to 4, typically within 1 day of receiving the procedure. Such pain relief appeared to be lasting in the 4 studies that reported long-term outcomes, although most of the studies had large losses to follow-up.

In terms of other outcomes, results generally showed improvement after kyphoplasty. For example, Coumans et al reported statistically significant improvements in several subscores of the Short Form-36 (SF-36), including physical function, mental health, pain, vitality, and social function. Crandall et al showed decreases in the amount of medication use over time, and Ledlie et al showed that the proportion of patients fully ambulatory increased after the procedure. Two nonrandomized studies that compared kyphoplasty with conservative management for treatment of osteoporotic fractures showed that patients receiving kyphoplasty had greater improvements in pain and function.

In terms of adverse outcomes, the most common adverse outcome reported in these studies was leakage of the cement outside of the vertebral body, occurring between 6% and 38% in 6 studies that reported its occurrence. The early literature review also identified a publication on treatment of pathologic compression fractures in which kyphoplasty and spinal radiosurgery were combined. The 2008 TEC Assessment found that although many case series had been published, there was a lack of rigorous comparative trials of kyphoplasty. Because case series studies are subject to many sources of bias and are generally not reliable evidence of efficacy, it was concluded that the evidence for kyphoplasty did not meet TEC criteria.
Beginning in 2009, data from randomized controlled trials (RCTs) began appearing in the literature. This policy is now focused on RCT data.

**Balloon Kyphoplasty**

**Osteoporotic Compression Fractures**

In 2009, Wardlaw et al reported on the findings of the FREE trial, an industry-sponsored multisite RCT in which 300 adult participants with 1 to 3 painful osteoporotic vertebral fractures of less than 3 months' duration were assigned to undergo kyphoplasty or conservative care. Twenty-four month results of this study were reported by Boonen et al in 2011 and by Van Meirhaeghe et al in 2013. This study was designed to examine efficacy and safety of kyphoplasty for the treatment of acute vertebral compression fractures. There was no blinding in this trial. Participants were recruited from 21 sites in 8 countries. Participants needed to have back pain of no more than 3 months' duration and the presence of at least 1 but no more than 3 acute vertebral fractures. Participants were evaluated at baseline, then at 1, 3, 6, 12, and 24 months after the procedure. The primary outcome was the difference in change from baseline to 1 month in the SF-36 Physical Component Summary (PCS) between the kyphoplasty and control groups.

A total of 138 participants who underwent kyphoplasty and 128 control patients completed 1 month of follow-up. Scores for the primary outcome, 1-month change in SF-36 PCS score, were significantly higher for those in the kyphoplasty group. The difference between the 2 groups was 5.2 points (95% confidence interval, 2.9 to 7.4; p <0.001). Data were available from 232 patients (77%) at 24 months. Kyphoplasty was associated with greater improvements in SF-36 PCS scores at 6-month follow-up (3.39 points), but not at 12 or 24 months. Greater improvement in back pain was observed over 24 months for kyphoplasty (-1.49 points) and remained statistically significant at 24 months. Participants in the kyphoplasty group also reported greater improvements in quality of life and Roland-Morris Disability Questionnaire (RMDQ) score at short-term follow-up. At 12 months, fewer kyphoplasty patients (26.4% vs 42.1%) had received physical therapy or walking aids, back braces, wheelchairs, miscellaneous aids, or other therapy. Fewer kyphoplasty patients used opioid medications through 6 months (29.8% vs 42.9%) and fewer pain medications through 12 months (51.7% vs. 68.3%). While not a study outcome, the authors also noted that patients who received kyphoplasty had approximately 60 fewer days of restricted activity during the year than controls. Other differences between the groups were no longer apparent at 12 months; possibly due to natural healing of fractures. At 24 months, there was no significant difference between groups in the number of patients with new radiographic vertebral fractures (47.5% for kyphoplasty, 44.1% for control). Two device-related serious adverse events (a spondylitis and an anterior cement migration) were reported.

Berenson et al reported the results of an international multicenter RCT in 2011. They enrolled 134 patients with cancer who were at least 21 years of age. Participants had at least 1 and not more than 3 painful VCFs. (These appear to be due to osteoporosis, rather than from a metastatic lesion.) The primary outcome was change in functional status from baseline at 1 month as measured by the RMDQ. Treatment allocation was not blinded, and the primary outcome at 1 month was analyzed using all participants with data both at baseline and at 1 month. Participants needed to have a pain score of at least 4 on a 0 to 10 scale. Crossover to the balloon kyphoplasty arm was allowed after 1 month. The authors report scores in the kyphoplasty and nonsurgical groups of 17.6 and 18.2 at baseline, respectively, and 9.10 and 18.0 at 1-month follow-up (p<0.001 for the between-group difference in scores).
In 2011, Edidin et al reported mortality risk in Medicare patients who had vertebral compression fractures and had been treated with vertebroplasty, kyphoplasty, or nonoperatively. This study was industry-funded. Using the U.S. Medicare data set, they identified 858,978 patients who had VCVFs between 2005 and 2008. The data set included 119,253 kyphoplasty patients and 63,693 vertebroplasty patients. Survival was calculated from the index diagnosis date until death or the end of follow-up (up to 4 years). Cox regression was used to evaluate the joint effect of multiple covariates, which included gender, age, race/ethnicity, patient health status, type of diagnosed fracture, site of service, physician specialty, socioeconomic status, year of diagnosis, and census region. After adjusting for covariates, patients in the operated cohort (vertebroplasty or kyphoplasty) were found to have a higher adjusted survival rate (60.8%) than patients in the nonoperated cohort (50.0%) and were 37% less likely to die. The adjusted survival rates for vertebroplasty or kyphoplasty were 57.3% and 62.8%, respectively, a 23% lower relative risk for kyphoplasty. As noted by the authors, a causal relationship cannot be determined from this study.

Section Summary
Two moderate-sized unblinded RCTs report short-term benefits for kyphoplasty on pain and other outcomes in patients with painful osteoporotic fractures. Similar results are seen in numerous case series that report large short-term improvements in pain following kyphoplasty. There are no sham-controlled RCTs that have been completed for this technique.

The major limitation of these RCTs was the lack of a sham procedure. Nonspecific or placebo effects can be quite large for an invasive procedure such as kyphoplasty in which there is not blinding. Due to the possible sham effect observed in the recent trials of vertebroplasty, the validity of results from non-sham-controlled trials are questionable. The placebo effect may be on the order of 6 to 7 mm on a 100-mm scale, for invasive procedures, and even larger effects (10%) were observed in the sham-controlled vertebroplasty trials. The analyses were appropriate; however, it would have been preferable to have the number of participants reporting a clinically meaningful change as the primary outcome. In cases of chronic pain, mean differences in continuous measures may not be reflective of the percent of patients who have a meaningful clinical response.

Due to the concerns about the validity of the available RCTs, it is difficult to come to conclusions regarding the efficacy of kyphoplasty. Despite most case series showing consistent improvements in pain after the procedure, and the same conclusion being reached in the 2 RCTs, it is not possible to conclude that these improvements are a true treatment effect, or a nonspecific, placebo effect.

Vertebral Body Metastasis
In the early literature reviews, 3 case series were reviewed evaluating a total of 52 patients. Outcome measures varied among these 3 studies, but all showed improvements either in VAS pain score, several aspects of physical functioning as measured by SF-36, or improvement in a disability score. There are no RCTs of kyphoplasty for vertebral body metastasis. Because the results of the comparative studies of vertebroplasty suggest possible placebo or natural history effects, case series are insufficient to make conclusions about the effect of kyphoplasty on health outcomes.
Vertebral Hemangiomas

For symptomatic vertebral body hemangioma with aggressive features, no studies reported pre- and postprocedure pain evaluations. Therefore, the findings of all studies that reported more than a single case (6 studies, totaling 64 patients) were evaluated. The studies using percutaneous cementoplasty as an adjunct to surgical treatment suggest that the use of percutaneous cementoplasty to treat the vertebral body component of the vascular lesion may contribute to avoiding the substantial blood loss that has been historically described with primary surgical resection (curettage). However, the additional use of other procedures in these studies may make it difficult to attribute the lower blood loss to this procedure. These studies do not provide controlled comparisons of the morbidity of treating hemangiomas with percutaneous cementoplasty as an adjunct to surgery and the morbidity of surgical treatment without cementoplasty.

Adverse Events

Yi et al assessed the occurrence of new vertebral compression fractures after treatment with cement augmenting procedures (vertebroplasty or kyphoplasty) versus conservative treatment in an RCT with 290 patients (363 affected vertebrae). Surgically treated patients were discharged the next day. Patients treated conservatively (pain medication, bedrest, a body brace, physiotherapy) had a mean length of stay of 13.7 days. Return to usual activity occurred at 1 week for 87.6% of operatively treated patients and at 2 months for 59.2% of conservatively treated patients. All patients were evaluated with radiographs and magnetic resonance imaging at 6 months and then at yearly intervals until the last follow-up session. At a mean follow-up of 49.4 months (range, 36–80), 10.7% of patients had experienced 42 new symptomatic vertebral compression fractures. There was no significant difference in the incidence of new vertebral fractures between the operative (18 total, 9 adjacent 9 nonadjacent) and conservative (24 total, 5 adjacent, 16 nonadjacent, 3 same level) groups, but the mean time to a new fracture was significantly shorter in the operative compared with nonoperative group (9.7 vs 22.4 months).

Cement leakage, although reduced in kyphoplasty relative to vertebroplasty, remains a concern. There continue to be case reports of right ventricle perforation, cardiac tamponade, and embolism of cement into pulmonary vessels.

Mechanical Vertebral Augmentation with Kiva versus Balloon Kyphoplasty

Kiva System as Vertebral Augmentation Treatment (KAST) is an industry-sponsored multicenter phase 3 randomized IDE trial (NCT01123512). Vertebral augmentation with the Kiva VCF System was compared with balloon kyphoplasty in 300 patients with 1 or 2 osteoporotic vertebral compression fractures. The study was completed in May 2013. Preliminary results of this study were presented at the Society for Interventional Radiology Annual Scientific Meeting in March 2014, reporting noninferiority of KIVA compared with kyphoplasty. However, this study has not yet been published in a peer-reviewed journal.

In 2013, Korovessis reported a randomized trial comparing mechanical vertebral augmentation with the Kiva device versus balloon kyphoplasty in 180 patients with osteoporotic vertebral body fractures. The groups showed similar improvements in VAS for back pain, SF-36, and Oswestry Disability Index (ODI). For example, there was a greater than 5.5 point improvement in VAS in 54% of patients in the Kiva group and 43% of patients in the balloon kyphoplasty group. Radiologic measures of vertebral height were similar in the 2 groups. Kiva reduced the Gardner kyphotic angle, while residual kyphosis of more than 5 degrees was
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more frequently observed in the balloon kyphoplasty group. Patients and outcome assessors were reported to be unaware of the group assignment, although it is not clear if the Kiva device was apparent in the radiographs. Cement leakage into the canal occurred in 2 patients treated with balloon kyphoplasty, necessitating decompression, compared with none following the Kiva procedure.

Another 2013 study was a retrospective matched pair comparison of Kiva versus balloon kyphoplasty in 52 patients with VCFs. Data were collected for the Kiva group between 2010 and 2011, and the data for the balloon kyphoplasty group were collected between 2004 and 2009. The 2 groups were matched for the vertebral body treated, age, and approximate caudal acantha. Back pain (numeric rating scale [NRS] for kyphoplasty and VAS for Kiva) and motility (ODI) were assessed preoperatively and at 6 months postoperatively. The mean operation time was 12.7 minutes per vertebra for Kiva and 46.5 minutes for balloon kyphoplasty. There was no significant difference in the incidence of cement extravasion between the Kiva (23.1%) and kyphoplasty (30.7%) groups. At 6-month follow-up, pain scores were significantly better in the Kiva group (10.8 NRS vs 24.6 VAS). The improvement in ODI was similar in the 2 groups (43.9 for Kiva, vs 47.4 for kyphoplasty). There were significantly fewer adjacent and nonadjacent fractures in the Kiva group (1 and 2) compared with the kyphoplasty group (9 and 5, both respectively). The mean postoperative height was 21.65 mm in the Kiva group compared with 25.09 mm in the balloon kyphoplasty group. It is not clear whether the difference in postoperative vertebral wall height for the 2 procedures is operator dependent, or whether this is a contributing factor in the occurrence of adjacent and nonadjacent fractures.

Section Summary
Evidence to date includes a preliminary report of a large industry-sponsored multicenter IDE trial, a large independent randomized trial, and a retrospective matched pair comparison. The IDE trial has not yet been published in a peer-reviewed journal. The matched pair comparison reported favorable outcomes for Kiva, although this study is limited by the retrospective nature of the study and the nonconcurrent controls.

Vertebral Body Stenting versus Balloon Kyphoplasty
An RCT by Werner et al, performed independent of industry support, found no advantage of VBS over balloon kyphoplasty. Sixty-five patients were included who had 1 or more fresh osteoporotic vertebral compression fractures and marked pain. A total of 100 VCFs were randomized to either VBS or balloon kyphoplasty, with the condition that if there were multiple levels in a single patient, the same procedure was used for all levels. There was no significant difference between the procedures in radiation time, or in the mean reduction of kyphosis (4.7 degrees after VBS and 4.5° after kyphoplasty). There was also no significant difference between the 2 intervention arms in cement leakage (20% balloon kyphoplasty and 30% VBS). Intraoperative pressure was higher and material-related complications were greater (9 of the 50 levels, including failure of the cannulas, incomplete or no opening of the stent, and balloon rupture) in the VBS group compared with 1 of the 50 vertebral levels (balloon rupture) in the kyphoplasty group.

Ongoing and Unpublished Clinical Trials
NCT01847898 is an industry-sponsored multicenter RCT that will compare vertebral body stenting vs kyphoplasty. The study is being conducted in Europe with approximately 100 patients enrolled. The study is ongoing, but no longer recruiting participants. Study completion is expected in September 2015.
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Clinical Input Received Through Physician Specialty Societies and Academic Medical Centers
While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

In response to requests, input was received from 6 physician specialty societies (1 unsolicited) and 2 academic medical centers while this policy was under review in 2008. All reviewers disagreed with the proposed policy, referring to a body of evidence from uncontrolled studies that support use of kyphoplasty.

Summary
After consideration of the available evidence and uniform clinical input, it was concluded that although the scientific evidence does not permit conclusions about the impact on health outcomes and that comparative studies with long-term outcomes are lacking; numerous case series, including large prospective reports, consistently showed that vertebroplasty or kyphoplasty may alleviate pain and improve function in patients with vertebral fractures who fail to respond to conservative treatment (at least 6 weeks) with analgesics, physical therapy, and rest. More recent randomized trials that compare kyphoplasty with medical management have also reported benefit, so have not changed these conclusions. Given the absence of alternative treatment options and the morbidity associated with extended bedrest, kyphoplasty may be considered a reasonable treatment option in patients with vertebral fractures who fail to improve after 6 weeks of conservative therapy and therefore may be considered medically necessary both for this patient population, as well as for patients who have severe pain due to osteolytic lesions of the spine related to multiple myeloma or metastatic malignancies.

There is insufficient evidence to permit conclusions on the use of kyphoplasty for an acute (<6 weeks) vertebral fracture. The scientific evidence does not permit conclusions about the impact on net health outcome; sham-controlled comparative studies are needed. There are no additional data to alter these conclusions.

There is a single published randomized trial on mechanical vertebral augmentation using the Kiva VCF System. Results from the pivotal FDA-regulated investigational device exemption trial have been reported as an abstract from a scientific meeting. In both trials, the Kiva system is compared with kyphoplasty and showed non-inferiority. Early evidence suggests that VBS may have worse outcomes compared with balloon kyphoplasty and is considered investigational.

Vertebroplasty and Sacroplasty
For treatment of osteoporosis and malignancy with percutaneous vertebroplasty or sacroplasty, the primary beneficial outcomes of interest are relief of pain and improvement in ability to function. Ex vivo cadaver studies reporting bone strength as a surrogate outcome measure have been reported but are not included in this evaluation of health outcomes. In treatment of aggressive hemangioma, the primary benefits of percutaneous vertebroplasty include relief of pain and reduction of blood loss associated with surgical treatment.
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Pain and functional ability are subjective outcomes and, thus, may be susceptible to placebo effects. Furthermore, the natural history of pain and disability associated with these conditions may be variable. Therefore, controlled comparison studies would be valuable to demonstrate the clinical effectiveness of vertebroplasty and sacroplasty over and above any associated nonspecific or placebo effects and to demonstrate the effect of treatment compared with alternatives such as continued medical management.

In all clinical situations, adverse effects related to complications from vertebroplasty and sacroplasty are the primary harms to be considered. Principal safety concerns relate to the incidence and consequences of leakage of the injected PMMA.

Literature Review

Percutaneous Vertebroplasty

The evidence on this question consists of a number of RCTs, 2 of which included a sham control, and many case series. This policy was originally based on a 2000 TEC Assessment and updated with TEC Assessments in 2004, 2005, 2008, 2009, and 2010. Originally, the available data were observational. The largest of the case series reported results from a prospectively collected database with 552 patients from a large academic department. Evidence from observational studies were generally consistent in showing significant decreases in pain from an initial preoperative level of 8 to 9 on a VAS, or similar score proportionate to the highest possible score to 2 to 4, typically within 1 day of receiving the procedure. Such pain relief appeared to be lasting in the limited studies that reported long-term outcomes. In terms of adverse outcomes, leakage of the cement outside of the vertebral body was a common event, occurring in between 19% and 72% in studies that reported its occurrence.

Beginning in 2007, data from RCTs began appearing in the literature. This policy is now focused on RCT data.

RCTs of Vertebroplasty Versus Medical Management With Sham Controls

In 2009, 2 randomized trials compared vertebroplasty with a medical management using a sham placebo control (that included local anesthetic), which mimicked the vertebroplasty procedure up to the point of cement injection. Buchbinder et al reported results of a 4-center, randomized, double-blind, sham-controlled trial that was designed to determine short-term efficacy and safety of vertebroplasty for alleviating pain and improving physical functioning in persons with painful osteoporotic vertebral fractures. A total of 78 subjects with 1 or 2 painful osteoporotic vertebral fractures of duration less than 1 year were assigned to undergo vertebroplasty or sham procedure (ie, injection of local anesthetic into the facet capsule and/or periosteum). Ninety-one percent of participants completed 6 months of follow-up. The participants, investigators (other than the radiologists performing the procedure), and outcome assessors were blind to the treatment assignment.

Recruitment took place within the practices of both general practitioners and specialists from hospital inpatient and emergency departments. In general, participants were required to have back pain of no more than 12 months and the presence of at least 1 but no more than 2 recent vertebral fractures. Participants were evaluated at baseline, then with a mailed questionnaire at 1 week and 1, 3, and 6 months after the procedure. The primary outcome was overall pain (over the course of the previous week) measured on a 0
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to 10 VAS, with 1.5 representing the minimal clinically important difference. A sample size of 24 per group was calculated to provide 80% power with 2-sided α 0.05 to show a 2.5-point post procedure difference assuming a 3-point standard deviation. All analyses were performed according to intention-to-treat (ITT) principles. Results are presented as difference from baseline. For the primary outcome of overall pain, the authors reported no significant difference in VAS pain score at 3 months. With reductions in pain and improvements in quality of life observed in both groups, the authors concluded vertebroplasty provided no benefit.

There was considerable variability in pain scores, which may in part be due to a lack of minimum pain score at entry. The primary outcome measure was the mean difference in VAS from baseline. For some continuous outcomes, such as pain, there is a magnitude of improvement that is clinically meaningful on an individual level; someone achieving that minimal change can be considered a responder. Under these circumstances, a fundamental limitation of continuous effect measures is failing to identify the proportion of patients experiencing a meaningful clinical response. Because a clinically meaningful important improvement has been established, the proportion of patients responding is an informative outcome that can supplement and extend the comparison of mean differences. Moreover, when considered in this manner, response or meaningful improvement (2.5 on the VAS) in overall pain at 1, 3, and 6 months tended to be more frequent with vertebroplasty—respective relative risks (RRs) of 1.2 (95% confidence interval [CI], 0.7 to 2.0), 1.5 (95% CI, 0.9 to 2.6), and 1.3 (95% CI, 0.8 to 2.1). However, detecting an increase in clinical response rates often requires larger numbers of patients. For example, detecting an increase in response from 40% (sham) to 60% with 80% power would have required a sample exceeding 200 participants. Also, at entry, many participants had experienced pain longer than 3 months, suggesting that the VAS may not be as responsive as other measures for these patients. This adds to the uncertainty as to whether a mean change in VAS will capture clinically meaningful improvement.

Kallmes et al conducted a multicenter, randomized, double-blind, sham-controlled trial (INVEST) in which 131 participants with 1 to 3 painful osteoporotic vertebral fractures were assigned to undergo vertebroplasty or sham procedure (injection of local anesthetic into the facet capsule and/or periosteum). Participants had back pain for no more than 12 months and had a current pain rating of at least 3 on VAS at baseline. Participants were evaluated at baseline, then again at various time points to 1 year postprocedure. Ninety-seven percent completed a 1-month follow-up, and 95% completed 3 months. The primary outcomes were scores on the RMDQ and average back pain intensity during the preceding 24 hours at 1 month, with a reduction of 30% on the RMDQ and VAS pain considered a clinically meaningful difference. The study initially had 80% power to detect differences in both primary and secondary outcomes with 250 patients, with a 2-sided alpha of 0.05 on the basis of a 2.5-unit advantage for vertebroplasty over placebo on the RMDQ and 1.0-point difference on VAS. After recruitment difficulty and interim analysis on the first 90 participants, target sample size was decreased to 130 participants with 80% power for primary aims maintained. All primary analyses were performed according to intention-to-treat principles and results presented as mean score for the RMDQ and pain intensity.

For the primary end points at 1 month, there were no significant between group differences. There was a trend toward a higher clinically meaningful improvement in pain at 1 month (30% reduction from baseline) in the vertebroplasty group (64% vs 48%, respectively; p=0.06). At 3 months, 43% from the control group vs
12% in the vertebroplasty group crossed over (p<0.001). The crossovers did not affect study outcomes, as they occurred after the primary outcome assessment. However, significantly more participants in the control group chose to cross over than in the vertebroplasty group. By 1 year, 16% of patients who underwent vertebroplasty and 60% of control subjects had crossed over to the alternative procedure (p<0.001). As-treated analysis found no significant difference in RMDQ or pain scores between the 2 groups. ITT analysis found a modest 1-point difference in pain rating, but no significant difference in RMDQ. There was a significant difference in the percentage of patients showing a 30% or greater improvement in pain (70% of patients randomized to vertebroplasty vs 45% of patients randomized to the control group).

Staples and colleagues conducted a patient-level meta-analysis of the 2 sham-controlled trials to determine whether vertebroplasty is more effective than sham in specific subsets of patients. This subset analysis focused on duration of pain (≤6 weeks vs >6 weeks) and severity of pain (score <8 or ≥8 on an 11-point numerical rating scale). Included in the analysis were 209 participants (78 from the Australian trial and 131 from the U.S. trial); 27% had pain of recent onset and 47% had severe pain at baseline. The primary outcome measures, pain scores and function on the RMDQ at 1 month, were not significantly different between groups. Responders’ analyses were also conducted based on a 3-unit improvement in pain scores, a 3-unit improvement on the RMDQ, and a 30% improvement in each of the pain and disability outcomes. The only difference observed between groups was a trend for a higher proportion of the vertebroplasty group to achieve at least 30% improvement in pain scores (RR=1.32; 95% CI, 0.98 to 1.76; p=0.07), a result that may have been confounded by the greater use of opioid medications in that group. Overall, this analysis does not support the hypothesis that selected subgroups of patients, including those with pain of 6 weeks’ duration or less or those with severe pain, would benefit from vertebroplasty.

**RCTs of Vertebroplasty Versus Medical Management Without Sham Controls**

VERTOS II, reported by Klazen et al in 2010, was an open-label prospective randomized trial of 202 patients at 6 hospitals in the Netherlands and Belgium. Participants with at least 1 painful osteoporotic vertebral fracture of a duration of 6 weeks or less were assigned to undergo vertebroplasty or conservative management (i.e., bed rest, analgesia, and cast and physical support). Ninety-three participants received vertebroplasty, while 95 received conservative management; 81% of participants completed 1-year follow-up. The trial was designed to assess the efficacy of vertebroplasty compared to conservative management for the treatment of osteoporotic vertebral compression fractures. There was no blinding of participants, investigators, or outcome assessors to treatment assignment, due to the lack of a sham procedure.

Participants were recruited after referral from their primary care provider for spine radiography because of back pain. In general, participants were required to be at least 50 years of age or older, have compression fracture with height loss of the vertebral body of at least 15% on x-ray of the spine, the level of fracture was T5 or lower back with pain of a duration of 6 weeks or less with a severity of at least 5 on the VAS. Participants were clinically evaluated at baseline, 1 day, 1 week, 1 month, 3 months, 6 months and 12 months after treatment. Primary outcome was pain relief at 1 month and 12 months measured on a 10-point VAS scale. A sample size of 100 per group was calculated to provide 80% power with an alpha of 0.05 to show a 25% difference in pain relief. All analyses were performed according to ITT principles. Clinically significant pain relief was defined as 30% change on the VAS (0-10 scale).
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One hundred one subjects were enrolled into the treatment group and 101 into the control arm; 81% completed 12-month follow-up. Except for the primary outcome, difference in mean pain score from baseline at 3 months and 12 months, vertebroplasty resulted in greater pain relief than did medical management at 1 month and 1 year; there were significant between group differences at 1 month (2.6; 1.74 to 3.37; p<0.001) and at 1 year (2.0; 1.13 to 2.80; p<0.001). Survival analysis showed significant pain relief was quicker (29.7 vs 115.6 days) and was achieved in more patients after vertebroplasty than after conservative management. There was cement leakage in 72% of patients after vertebroplasty, with all patients remaining asymptomatic, and at a mean of 11.4 months’ follow-up, there was no significant difference in number of new fractures between groups, with 18 new fractures in 15 patients who had vertebroplasty compared with 30 new fractures in 21 participants undergoing medical management.

A methodologic strength of this study is the study’s focus on acute fracture, a subset of those with osteoporotic vertebral compression fractures, while other studies (Buchbinder et al 2009; Kallmes et al 2009) enrolled participants with pain out to 1 year. The inclusion of both chronic and acute fractures may mask the efficacy of the procedure in 1 subset. Klazen et al also provided an a priori definition of clinically significant change in pain as one that registered a 30% difference on the 10-point VAS. These data were incorporated as events in a survival analysis as part of the analysis of the primary outcome.

A subsequent report from the VERTOS II study described the 12-month natural history of pain in patients in the conservative treatment arm. Patients in the control arm were followed until pain relief was achieved, defined as a VAS score of 3 or less. Results were analyzed by Kaplan-Meier survival analysis. By 12-month follow-up, 57 of 95 patients (60%) were considered to have sufficient pain relief, with most experiencing sufficient pain relief in the first 3 months. Comparison by logistic regression analysis with the 38 patients (40%) who still had pain (VAS ≥4) at 12 months did not reveal any significant differences between the groups for the clinical and imaging factors that were evaluated.

In 2011, Farrokhi et al reported a randomized trial that compared vertebroplasty with optimal medical management in 82 patients. Patients had painful osteoporotic vertebral compression fractures that were refractory to analgesic therapy for at least 4 weeks and less than 1 year. The patients and the physicians involved in the treatment of the patients were not aware of the treatment that the other group was receiving. Control of pain and improvement in quality of life were measured by independent raters before treatment and at 1 week and 2, 6, 12, 24, and 36 months after the beginning of treatment. Radiologic evaluation to measure vertebral body height and correction of deformity was performed before and after treatment and after 36 months of follow-up. At 1 week, the mean VAS score decreased from 8.4 to 3.3 in the vertebroplasty group and from 7.2 to 6.4 in the conservative management group, with between group differences that remained significant through 6 months of follow-up. Group differences on the Oswestry lower back pain score were significantly lower in the vertebroplasty group throughout the 36 months of the study. New symptomatic adjacent fractures developed in 1 patient (2.6%) in the vertebroplasty group and 6 patients (15.4%) in the conservative management group. In 1 patient, epidural cement leakage caused severe lower extremity pain and weakness that was treated with bilateral laminectomy and evacuation of bone cement.
Rousing et al reported on a nonblinded randomized trial in which participants were randomized to either vertebroplasty or conservative management. These participants had no conservative therapy before enrolling in the trial. The study enrolled 40 participants with acute fractures and 10 with subacute (2-8 weeks). While immediate pain relief was observed in the vertebroplasty group, reductions in pain from baseline to 3-month follow-up were similar for the two groups. The authors concluded that conservative management should be used in the acute phase. The primary limitations of this study include its small size and incomplete pain assessment at the baseline visit.

The VERTOS study was a small RCT of 34 patients. Patients had been refractory to medical management for at least 6 weeks and no longer than 6 months. The authors noted that many patients had been referred for vertebroplasty following failed conservative treatment and did not want to be randomized to the optimized medication control group or chose to crossover to vertebroplasty after only 2 weeks of conservative treatment. Thus, the follow-up in the study was very short. Vertebroplasty was found to decrease analgesic use (1.9 to 1.2 vs 1.7 to 2.6 in the optimized medication group) and resulted in a 19% improvement in the RMDQ (vs -2% in controls) 2 weeks after the procedure. Excluding 2 patients (11%) who had adjacent vertebral compression fractures by the 2-week follow-up, mean VAS scores for pain decreased from 7.1 to 4.4 (vs 7.6 to 6.4 for controls). Patients who crossed over from conservative management to vertebroplasty had improvements after the procedure.

Section Summary
Despite the completion of 5 RCTs, including 2 with sham control, the efficacy of vertebroplasty for painful osteoporotic compression fractures remains uncertain. The 2 randomized, sham-controlled trials concluded that vertebroplasty showed no significant benefit above sham for painful osteoporotic fractures. However, some uncertainty remains around the interpretation of their conclusions. While the use of a sham procedure is a major methodologic strength to control for nonspecific (placebo) effects, the sham used in the trial is not without controversy, as it might be considered an active control, given that the effect of injecting local anesthetic in the facet capsule and/or periosteum is unknown. Without a clear understanding of the short- and long-term effects of the injection on pain, questions will remain. Also, both trials were underpowered to observe and compare the proportion of participants experiencing a clinically meaningful difference in pain, which is the most clinically relevant outcome measure. Furthermore, the responder outcome measures in both trials showed trends toward an improvement in the rate of meaningful clinical response, although the differences between groups were not statistically significant.

In contrast, the 4 RCTs without sham control report that vertebroplasty is associated with significant improvements in pain. Three of the 4 trials were small, and the studies included populations with different time periods of symptoms and different prior treatments. It is possible that the effect reported in these nonsham controlled trials is due to a placebo effect, given that these studies were not blinded and the outcome of pain is a subjective, patient-reported outcome that is prone to the placebo effect. It is also possible that the differences in these trials represents a true treatment effect and that the sham control had a therapeutic effect in reducing short-term pain, thus obscuring any impact of vertebroplasty.
Other Studies

Although not randomized, there was another comparative study specifically aimed at patients with acute fracture. Diamond et al enrolled 79 consecutive patients with acute vertebral fractures. All patients were offered vertebroplasty, and those who declined were followed as a comparison group. The 2 groups had balanced baseline characteristics. At 24 hours, the group undergoing vertebroplasty (n=55) had much improved pain compared with the control group (n=24). However, at 6 weeks and between 6 and 12 months, there were no differences between groups in pain scores. The control group had an identical mean pain score to the vertebroplasty group at the end of follow-up. Similar findings were shown for the Barthel index of physical functioning. At long-term follow-up, there was still slightly higher functioning in the group undergoing vertebroplasty but no difference in the percent improvement from baseline between groups. The authors interpreted these findings as demonstrating that vertebroplasty produced faster resolution of symptoms than conservative management, as was shown in the Klazen trial.

In 2011, Edidin et al reported mortality risk in Medicare patients who had vertebral compression fractures and had been treated with vertebroplasty, kyphoplasty or nonoperatively. This study was industry-funded. Using the U.S. Medicare data set, they identified 858,978 patients who had vertebral compression fractures between 2005 and 2008. The data set included 119,253 kyphoplasty patients and 63,693 vertebroplasty patients. Survival was calculated from the index diagnosis date until death or the end of follow-up (up to 4 years). Cox regression was used to evaluate the joint effect of multiple covariates, which included gender, age, race/ethnicity, patient health status, type of diagnosed fracture, site of service, physician specialty, socioeconomic status, year of diagnosis, and census region. After adjusting for covariates, patients in the operated cohort (vertebroplasty or kyphoplasty) were found to have a higher adjusted survival rate (60.8%) than patients in the nonoperated cohort (50.0%) and were 37% less likely to die. The adjusted survival rates for vertebroplasty or kyphoplasty were 57.3% and 62.8%, respectively, a 23% lower relative risk for kyphoplasty. As noted by the authors, a causal relationship cannot be determined from this study.

Adverse Events

Yi et al assessed the occurrence of new vertebral compression fractures after treatment with cement augmenting procedures (vertebroplasty or kyphoplasty) versus conservative treatment in an RCT with 290 patients (363 affected vertebrae). Surgically treated patients were discharged the next day. Patients treated conservatively (pain medication, bed rest, body brace, physiotherapy) had a mean length of stay of 13.7 days. Return to usual activity occurred at 1 week for 87.6% of operatively treated patients and at 2 months for 59.2% of conservatively treated patients. All patients were evaluated with radiographs and magnetic resonance imaging at 6 months and then at yearly intervals until the last follow-up session. At a mean follow-up of 49.4 months (range, 36-80), 10.7% of patients had experienced 42 new symptomatic vertebral compression fractures. There was no significant difference in the incidence of new vertebral fractures between the operative (18 total; 9 adjacent, 9 nonadjacent) and conservative (24 total; 5 adjacent, 16 nonadjacent, 3 same level) groups, but the mean time to a new fracture was significantly shorter in the operative compared with nonoperative group (9.7 vs 22.4 months).

A systematic review of the safety and efficacy of vertebroplasty in malignancy was reported by Chew et al in 2011. Thirty relevant studies were identified, totaling 987 patients. Included in the review were a single randomized controlled trial and 7 prospective studies. Most centers reported treating no more than 4
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Vertebrae per session. Pain reduction ranged between 20% and 79%. Five deaths were attributable to vertebroplasty, 2 from chest infections following general anesthesia, 1 from a cement pulmonary embolus, and 2 from sepsis after emergency spinal decompression. Another 19 patients suffered a serious complication related to the procedure, with 13 requiring emergency spinal decompression. Reports of complications occurred in studies with a mean cement volume of more than 4 mL, suggesting a possible association between the volume of cement injected and adverse events.

In 2012, Wang et al reported a systematic review of pulmonary cement embolism (PCE) associated with percutaneous vertebroplasty. PCE was noted in 50 cases in observational studies, with a reported incidence ranging from 2.1% in retrospective observational studies to 26% in prospective observational studies that had standard postprocedural chest. There were an additional 34 patients identified from case reports with PCE, 30 of whom were symptomatic. Five deaths due to PCE after vertebroplasty have been reported.

**Percutaneous Sacroplasty**

Sacroplasty is an evolving technique with numerous methods (short axis, long axis, balloon-assisted short axis, iliosacral screws). No randomized trials of sacroplasty have been reported. The largest prospective report is an observational cohort study of 52 consecutive patients undergoing sacroplasty for sacral insufficiency fractures using the short-axis technique. Patients had a mean age of 75.9 years and a mean duration of symptoms of 34.5 days (range, 4-89 days) and mean VAS score of 8.1 at baseline. Improvement on the VAS scale was measured at 30 minutes and 2, 4, 12, 24, and 52 weeks postprocedure. At each interval, statistically significant improvement over baseline was observed and maintained through 52 weeks.

The largest series is a retrospective multicenter analysis of 204 patients with painful sacral insufficiency fractures and 39 patients with symptomatic sacral lesions treated with either the short-axis or long-axis technique. One hundred sixty-nine patients had bilateral sacral insufficiency fractures and 65 patients had additional fractures of the axial skeleton. VAS improved from 9.2 before treatment to 1.9 after treatment in patients with sacral insufficiency fractures, and from 9.0 to 2.6 in patients with sacral lesions. There was 1 case of radicular pain due to extravasation of cement requiring surgical decompression.

There are several retrospective reviews with about 50 patients each. One of these described a series of 57 patients treated with sacroplasty for sacral insufficiency fractures. The short- or long-axis approach was dictated by the length and type of the fracture and patient anatomy. Follow-up data at 2.5 weeks was available for 45 patients (79%), and the outcome measures were inconsistent. For example, activity pain scores were collected from 13 patients, and rest pain scores were collected from 29 patients. Of the 45 patients with outcome data, 37 (82%) were reported to have experienced either a numerical or descriptive decrease from initial pain of at least 30%.

Additional literature reports are mostly consistent reporting immediate improvement following the procedure. Due to the small size of the evidence base, harms associated with sacroplasty have not been adequately studied. There are complications of cement leakage with sacroplasty that are not observed with vertebroplasty. Leakage of PMMA into the presacral space, spinal canal, sacral foramen, or sacroiliac joint...
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may result in pelvic injection of PMMA, sacral nerve root or sacral spinal canal compromise, or sacroiliac joint dysfunction. Performing sacroplasty only on zone 1 fractures can minimize these risks.

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

In response to requests, input was received from 5 physician specialty societies and 2 academic medical centers while this policy was under review in 2008. Unsolicited input was received from a sixth physician specialty society. All reviewers disagreed with the proposed policy and provided references in support of the use of vertebroplasty.

Summary
Vertebroplasty has been investigated as an intervention to provide mechanical support and symptomatic relief in patients with osteoporotic vertebral compression fracture or in those with osteolytic lesions of the spine, ie, multiple myeloma or metastatic malignancies. The results of clinical vetting in 2008 indicated uniform support for the use of vertebroplasty in painful osteoporotic fractures. After consideration of the available evidence and clinical input, it was concluded that the consistent results of numerous case series, including large prospective reports, together with the results of clinical vetting, were sufficient to determine that vertebroplasty was a reasonable treatment option in patients with vertebral fractures who fail to respond to conservative treatment (at least 6 weeks with analgesics, physical therapy, and rest). Given the absence of alternative treatment options and the morbidity associated with extended bed rest, vertebroplasty may be considered medically necessary in patients with vertebral fractures who fail to improve after 6 weeks of conservative therapy.

Subsequent literature updates performed after 2008, including 2 sham-controlled trials, have raised questions about the efficacy of vertebroplasty for osteoporotic fractures. These trials can be interpreted as showing that vertebroplasty is ineffective. However, alternate interpretations are possible. There are methodologic issues with these studies, including but not limited to the choice of sham procedure and the potential effect of the sham procedure having a therapeutic effect by reducing pain. Also, the appropriateness of chosen outcome measures to detect clinically meaningful differences in pain may not have been optimal, as the studies were underpowered to detect differences in clinical response rates. Because of these uncertainties in the interpretation of the literature, the policy is unchanged.

There is insufficient evidence to permit conclusions on the use of vertebroplasty for acute fractures. The VERTOS II trial is a well-done study, whose results should be replicated and verified. For acute fractures, conservative therapy consisting of rest, analgesics, and physical therapy is an option, and symptoms will resolve in a large percentage of patients with conservative treatment only. Therefore, the use of vertebroplasty for acute osteoporotic fractures is considered investigational.
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Sacroplasty is under development. Small numbers of treated patients leaves uncertainty regarding the impact of sacroplasty on health outcomes and does not permit conclusion on its use for sacral insufficiency fractures or other indications. Therefore, sacroplasty is considered investigational.

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01/26/2004  Managed Care Advisory Council approval
01/04/2005  Medical Director review
01/18/2005  Medical Policy Committee review. Format revision. Policy statement added to clarify that all other uses are considered investigational. Coverage eligibility unchanged.
01/31/2005  Managed Care Advisory Council approval
01/04/2006  Medical Director review
01/17/2006  Medical Policy Committee review. Format revision.
02/23/2006  Quality Care Advisory Council approval
02/07/2007  Medical Director review
02/21/2007  Medical Policy Committee approval. Coverage eligibility for percutaneous kyphoplasty changed to investigational. Coverage statement for percutaneous vertebroplasty remains unchanged.
08/06/2008  Medical Director review
08/20/2008  Medical Policy Committee approval. Added coverage for kyphoplasty.
08/06/2009  Medical Policy Committee approval.
08/26/2009  Medical Policy Implementation Committee approval. No change to coverage eligibility.
12/01/2010  Medical Policy Committee review
02/01/2011  Coding revision
12/08/2011  Medical Policy Committee review
12/21/2011  Medical Policy Implementation Committee approval. Policy updated with literature search; sacroplasty added to the document. Title changed to include sacroplasty. References updated. Policy statement added to state that sacroplasty considered investigational.
12/06/2012  Medical Policy Committee review
12/19/2012  Medical Policy Implementation Committee approval. No change to coverage.
12/12/2013  Medical Policy Committee review
12/18/2013  Medical Policy Implementation Committee approval. Coverage eligibility unchanged.
06/05/2014  Medical Policy Committee review
06/18/2014  Medical Policy Implementation Committee approval. Added new investigational statement regarding Kiva and vertebral body stenting.
08/03/2015  Coding update: ICD10 Diagnosis code section added; ICD9 Procedure code section removed
09/03/2015  Medical Policy Committee review
09/23/2015  Medical Policy Implementation Committee approval. No change to coverage.
01/01/2016  Coding update
05/05/2016  Medical Policy Committee review
05/18/2016  Medical Policy Implementation Committee approval. Added mechanical vertebral augmentation (with Kiva) to coverage statement and title, removed from INV statement.
01/01/2017  Coding update: Removing ICD-9 Diagnosis Codes

Next Scheduled Review Date: 05/2017

Coding
The five character codes included in the Blue Cross Blue Shield of Louisiana Medical Policy Coverage Guidelines are obtained from Current Procedural Terminology (CPT®)†, copyright 2015 by the American Medical Association (AMA). CPT is developed by the AMA as a listing of descriptive terms and five character identifying codes and modifiers for reporting medical services and procedures performed by physician.

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Percutaneous Vertebroplasty, Kyphoplasty, Mechanical Vertebral Augmentation and Sacroplasty

Policy # 00094
Original Effective Date: 11/21/2002
Current Effective Date: 05/18/2016

information contained in Blue Cross Blue Shield of Louisiana Medical Policy Coverage Guidelines. Fee schedules, relative value units, conversion factors and/or related components are not assigned by the AMA, are not part of CPT, and the AMA is not recommending their use. The AMA does not directly or indirectly practice medicine or dispense medical services. The AMA assumes no liability for data contained or not contained herein. Any use of CPT outside of Blue Cross Blue Shield of Louisiana Medical Policy Coverage Guidelines should refer to the most current Current Procedural Terminology which contains the complete and most current listing of CPT codes and descriptive terms. Applicable FARS/DFARS apply.

CPT is a registered trademark of the American Medical Association.

Codes used to identify services associated with this policy may include (but may not be limited to) the following:

<table>
<thead>
<tr>
<th>Code Type</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPT</td>
<td>0200T, 0201T, 22510, 22511, 22512, 22513, 22514, 22515</td>
</tr>
<tr>
<td>HCPCS</td>
<td>No codes</td>
</tr>
<tr>
<td>ICD-10 Diagnosis</td>
<td>C41.2, C79.51-C79.52, C90.00-C90.02, D18.09, D47.Z9, M48.50XA-M48.58XA, M58.08XA, M80.88XA</td>
</tr>
</tbody>
</table>

*Investigational – A medical treatment, procedure, drug, device, or biological product is Investigational if the effectiveness has not been clearly tested and it has not been incorporated into standard medical practice. Any determination we make that a medical treatment, procedure, drug, device, or biological product is Investigational will be based on a consideration of the following:

A. Whether the medical treatment, procedure, drug, device, or biological product can be lawfully marketed without approval of the U.S. FDA and whether such approval has been granted at the time the medical treatment, procedure, drug, device, or biological product is sought to be furnished; or

B. Whether the medical treatment, procedure, drug, device, or biological product requires further studies or clinical trials to determine its maximum tolerated dose, toxicity, safety, effectiveness, or effectiveness as compared with the standard means of treatment or diagnosis, must improve health outcomes, according to the consensus of opinion among experts as shown by reliable evidence, including:

1. Consultation with the Blue Cross and Blue Shield Association technology assessment program (TEC) or other nonaffiliated technology evaluation center(s);
2. Credible scientific evidence published in peer-reviewed medical literature generally recognized by the relevant medical community; or
3. Reference to federal regulations.

**Medically Necessary (or “Medical Necessity”) - Health care services, treatment, procedures, equipment, drugs, devices, items or supplies that a Provider, exercising prudent clinical judgment, would provide to a patient for the purpose of preventing, evaluating, diagnosing or treating an illness, injury, disease or its symptoms, and that are:

A. In accordance with nationally accepted standards of medical practice;

B. Clinically appropriate, in terms of type, frequency, extent, level of care, site and duration, and considered effective for the patient's illness, injury or disease; and

C. Not primarily for the personal comfort or convenience of the patient, physician or other health care provider, and not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of that patient's illness, injury or disease.

For these purposes, “nationally accepted standards of medical practice” means standards that are based on credible scientific evidence published in peer-reviewed medical literature generally recognized by the relevant medical community, Physician Specialty Society recommendations and the views of Physicians practicing in relevant clinical areas and any other relevant factors.

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