



Kansas City

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## Percutaneous Vertebroplasty and Sacroplasty

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**Origination:** 2/2001

**Last Review:** 11/2013

**Next Review:** 11/2014

### **Policy**

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

### **When Policy Topic is covered**

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Percutaneous vertebroplasty may be considered **medically necessary** 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.

Percutaneous vertebroplasty may be considered **medically necessary** for the treatment of severe pain due to osteolytic lesions of the spine related to multiple myeloma or metastatic malignancies.

### **When Policy Topic is not covered**

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Percutaneous vertebroplasty is considered **investigational** for all other indications, including use in acute vertebral fractures due to osteoporosis or trauma.

Percutaneous sacroplasty is considered **investigational** for all indications, including use in sacral insufficiency fractures due to osteoporosis and spinal lesions due to metastatic malignancies or multiple myeloma.

### **Description of Procedure or Service**

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#### **Percutaneous Vertebroplasty**

Percutaneous vertebroplasty (PVP) is an interventional radiology technique involving the fluoroscopically guided injection of polymethylmethacrylate (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, i.e., multiple myeloma or metastatic malignancies. Percutaneous vertebroplasty has also been investigated as an adjunct to surgery for aggressive vertebral body hemangiomas, as a technique to limit blood loss related to surgery. The technique has been used in all levels of the vertebrae, i.e., cervical, thoracic, and lumbar.

It has been proposed that PVP 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, since PMMA undergoes a heat-releasing (exothermic) reaction during its hardening process.

Vertebroplasty is a surgical procedure and, as such, is not subject to U.S. Food and Drug Administration (FDA) approval. PMMA bone cement was available as a drug product prior to enactment of the 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. The FDA issued a guidance document on July 17, 2002 (last accessed September 2002, available online at: <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 prior to 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 pathological fractures of the vertebral body using vertebroplasty or kyphoplasty procedures.

The FDA also issued a “Public Health Web Notification: Complications related to the use of bone cement in vertebroplasty and kyphoplasty procedures,” which is available online 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, the FDA’s voluntary reporting program.

### **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, (1,2) it is most often described as a minimally invasive procedure employed as an alternative to conservative management (3-5) for sacral insufficiency fractures (SIFs). SIFs are the consequence of excessive stress on weakened bone and are often the cause of low back pain among the elderly. Osteoporosis is the most common risk factor for SIF.

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.

### **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 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.

### **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. (6,7) 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. (6,8)

### **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 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.

\*Note: Percutaneous kyphoplasty is addressed in a separate policy.

### **Rationale**

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This policy was created in 2000 and updated periodically using the MEDLINE database. The most recent literature update was performed through March 4, 2013. Following is a summary of key studies to date.

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.

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 to 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 randomized clinical trials (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. (9-14) 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. (15) Evidence from observational studies were generally consistent in showing significant decreases in pain from an initial preoperative level of 8 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 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 to a medical management using a sham placebo control (that included local anesthetic), which mimicked the vertebroplasty procedure up to the point of cement injection. (16, 17) Buchbinder and colleagues 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 participants with 1 or 2 painful osteoporotic vertebral fractures of duration less than 1 year were assigned to undergo vertebroplasty or sham procedure (i.e., injection of local anesthetic into the facet capsule and/or periosteum). (16) 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 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  $\alpha$  0.05 to show a 2.5-point post-procedure difference assuming a 3-point standard deviation (SD). All analyses were performed according to intention-to-treat 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. (18) Since 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. (19) 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, (20) suggesting that the VAS may not be as responsive as other measures for these patients. (20) 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 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). (17) 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 post-procedure. Ninety-seven percent completed a 1-month follow-up, and 95% completed 3 months. The primary outcomes were scores on the Roland-Morris Disability Questionnaire (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. (21) 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 endpoints 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.

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. (22) This subset analysis focused on duration of pain ( $\leq 6$  weeks vs.  $>6$  weeks) and severity of pain (score  $<8$  or  $\geq 8$  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. (23) Participants with at least one 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 Th5 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 intention-to-treat principles. Clinically significant pain relief was defined as 30% change on the VAS (0-10 scale).

One hundred and one participants were enrolled into the treatment group and 101 into the control arm; 81% completed 12 months' 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,  $p < 0.0001$ ) and at 1 year (2.0; 1.13 to 2.80,  $p < 0.0001$ ). 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 to 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 [16]; Kallmes et al. 2009 [17]) enrolled participants with pain out to 1 year. The inclusion of both chronic and acute fractures may mask the efficacy of the procedure in one subset. Klazen and colleagues also provided an a priori definition of clinically significant change in pain as one that registered a 30% difference on the 10-point VAS. (23) 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. (24) 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  $\geq 4$ ) at 12 months did not reveal any significant differences between the groups for the clinical and imaging factors that were evaluated.

In 2011, Farrokhi and colleagues reported a randomized trial that compared vertebroplasty with optimal medical management in 82 patients. (25) 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. Radiological 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. (26) reported on a nonblinded randomized trial in which participants were randomized to either vertebroplasty or conservative management. These participants had no conservative therapy prior to 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 in 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 randomized clinical trial of 34 patients. (27) 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

following 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.

Conclusions. 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 non-sham 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 one other comparative study specifically aimed at patients with acute fracture. Diamond et al. enrolled 79 consecutive patients with acute vertebral fractures. (28) 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 to 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. (29) 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.

A systematic review of the safety and efficacy of vertebroplasty in malignancy was reported by Chew et al. in 2011. (30) 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 vertebrae per session. Pain reduction ranged between 20% to 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. (31) 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, and 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. (32) 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. (33) One hundred and 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 one case of radicular pain due to extravasation of cement requiring surgical decompression.

Another series was a retrospective review of 57 patients treated with sacroplasty under computed tomography (CT) guidance for sacral insufficiency fractures. (34) 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 polymethylmethacrylate (PMMA) into the presacral space, spinal canal, sacral foramen, or sacroiliac joint may result in pelvic injection of PMMA, sacral nerve root or sacral spinal canal compromise, or sacroiliac joint dysfunction. (35) Performing sacroplasty on Zone 1 fractures only can minimize these risks. (36)

### **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, i.e., 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 prospectivereports, 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 (28) 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.

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.

### **Practice Guidelines and Position Statements**

In 2012, a joint practice guideline on the performance of vertebral augmentation was published by the American College of Radiology (ACR), the American Society of Neuroradiology (ASN), the American Society of Spine Radiology (ASSR), the Society of Interventional Radiology (SIR), and the Society of Neurointerventional Surgery (SNIS). (37) This guideline addresses vertebral augmentation in general and refers to all percutaneous techniques used to achieve internal vertebral body stabilization, including vertebroplasty, balloon kyphoplasty, radiofrequency ablation and coblation, mechanical void creation, and injection of bone graft material or bone substitutes. The ACR, ASN, ASSR, SIR, and SNIS consider vertebral augmentation to be an established and safe procedure and provide guidelines for appropriate patient selection, qualifications and responsibilities of personnel, specifications of the procedure, equipment quality control, and quality improvement and documentation.

The ACR published appropriateness criteria on the management of vertebral compression fractures in 2010. (38) While generally supportive of vertebroplasty and kyphoplasty in specified conditions, the guidelines state that “conservative management is the first-line and gold standard treatment of painful

vertebral compression fractures....Most patients with osteoporotic vertebral compression fractures, even without medication, have spontaneous resolution of pain within 4 to 6 weeks from the initial onset of pain. From the inception of vertebral augmentation in the late 1980s, its minimally invasive procedures have been reserved for patients who have failed conservative therapy. Failure can be defined as pain refractory to oral medications (NSAIDs [nonsteroidal anti-inflammatory drugs] and/or narcotic) over 6-12 weeks. However, failure can also be defined as contraindications to such medications or a requirement for parenteral narcotics and hospital admission.”

In 2010, the American Academy of Orthopaedic Surgeons (AAOS) Board of Directors approved a new clinical practice guideline on the treatment of osteoporotic spinal compression fractures, which is available online at: <http://www.aaos.org/Research/guidelines/SCFguideline.asp>. The Board approved a strong recommendation against the use of vertebroplasty for patients who “present with an osteoporotic spinal compression fracture on imaging with correlating clinical signs and symptoms and who are neurologically “intact.” In coming out with a strong recommendation, the committee expressed their confidence that future evidence is unlikely to overturn the existing evidence. As a note, these recommendations were based on a literature review through September 2009; therefore, the Klazen et al. trial was not included in the systematic review.

The United Kingdom’s National Institute for Health and Care Excellence (NICE) concluded in 2003 that the current evidence on the safety and efficacy of vertebroplasty for vertebral compression fractures appears adequate to support the use of this procedure to provide pain relief for people with severe painful osteoporosis with loss of height and/or compression fractures of the vertebral body. (39) The guidance recommends that the procedure be limited to patients whose pain is refractory to more conservative treatment.

In 2008, NICE recommended consideration of vertebroplasty for patients with vertebral metastases and no evidence of metastatic spinal cord compression or spinal instability if they have mechanical pain resistant to conventional analgesia or vertebral body collapse. (40)

Consider vertebroplasty[4] or kyphoplasty[5] for patients who have vertebral metastases and no evidence of MSCC or spinal instability if they have:

- mechanical pain resistant to conventional analgesia, or
- vertebral body collapse.

1.5.1.9 Vertebroplasty or kyphoplasty for spinal metastases should only be performed after agreement between appropriate specialists (including an oncologist, interventional radiologist, and spinal surgeon), with full involvement of the patient and in facilities where there is good access to spinal surgery.

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### **Billing Coding/Physician Documentation Information**

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<b>22520</b>	Percutaneous vertebroplasty, one vertebral body, unilateral or bilateral injection; thoracic
<b>22521</b>	Percutaneous vertebroplasty, one vertebral body, unilateral or bilateral injection; lumbar
<b>22522</b>	Percutaneous vertebroplasty, one vertebral body, unilateral or bilateral injection; each additional thoracic or lumbar vertebral body (List separately in addition to code for primary procedure)
<b>72291</b>	Radiological supervision and interpretation, percutaneous vertebroplasty or vertebral augmentation including cavity creation, per vertebral body; under fluoroscopic guidance
<b>72292</b>	Radiological supervision and interpretation, percutaneous vertebroplasty or vertebral augmentation including cavity creation, per vertebral body; under CT guidance
<b>0200T</b>	Percutaneous sacral augmentation (sacroplasty), unilateral injection(s), including the use of a balloon or mechanical device, when used, 1 or more needles
<b>0201T</b>	Percutaneous sacral augmentation (sacroplasty), bilateral injections, including the use of a balloon or mechanical device, when used, 2 or more needles
<b>S2360</b>	Percutaneous vertebroplasty, one vertebral body, unilateral or bilateral injection; cervical
<b>S2361</b>	Each additional cervical vertebral body (list separately in addition to code for primary procedure)

### **Additional Policy Key Words**

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N/A

### **Policy Implementation/Update Information**

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2/1/01	New policy. Added to Radiology section, considered medically necessary for certain indications.
2/1/02	No policy statement changes.
2/1/03	No policy statement changes. Added CPT codes.

6/1/04	Policy statement revised to include discussion of percutaneous kyphoplasty as investigational. Policy statement revised to indicate percutaneous vertebroplasty as investigational except when pain is severe and debilitating, and cannot be relieved by correct medical therapy, other causes of pain, such as herniated intervertebral disk have been ruled out, and the affected vertebra has not been extensively destroyed and is at least one-third of its original height.
2/1/05	No policy statement changes.
2/1/06	Added to Surgery section. Removed percutaneous kyphoplasty from this policy and is now discussed under a separate policy.
2/1/07	No policy statement changes. Coding Updated.
2/1/08	No policy statement changes.
10/7/08	Policy statement revised; medically necessary if not responding to conservative treatment.
11/1/09	No policy statement changes.
11/1/10	Policy statement revised to indicate use in acute vertebral fractures as investigational.
11/1/11	Policy revised to include percutaneous sacroplasty (previously addressed in a separate policy); remains investigational. No changes to the policy statements on percutaneous vertebroplasty.
11/1/12	No policy statement changes.
11/1/13	No policy statement changes.

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