



MASSACHUSETTS

Blue Cross Blue Shield of Massachusetts is an Independent Licensee of the Blue Cross and Blue Shield Association

Medical Policy

Percutaneous Vertebroplasty and Sacroplasty

Table of Contents

- [Policy: Commercial](#)
- [Coding Information](#)
- [Information Pertaining to All Policies](#)
- [Policy: Medicare](#)
- [Description](#)
- [References](#)
- [Authorization Information](#)
- [Policy History](#)
- [Endnotes](#)

Policy Number: 484

BCBSA Reference Number: 6.01.25

NCD/LCD: Local Coverage Determination (LCD): Vertebroplasty and Vertebral Augmentation (Percutaneous) (L33569)

Related Policies

- Percutaneous Balloon Kyphoplasty, Radiofrequency Kyphoplasty, and Mechanical Vertebral Augmentation, #485
- Diagnosis and Treatment of Sacroiliac Joint Pain, #320

Policy

Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity

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, or
- Severe pain due to osteolytic lesions of the spine related to multiple myeloma or metastatic malignancies.

And when:¹

- There is a high degree of certainty through targeted, documented physical exam and ancillary studies (e.g., x-ray, MRI, CT, fluoroscopy, bone scan), that the pain is being caused by a non-healing fracture, AND
- The procedure is not being performed on a prophylactic basis, either for osteoporosis of the spine or chronic back pain, even if associated with old, healed compression fracture(s).

Percutaneous vertebroplasty may be considered **MEDICALLY NECESSARY** for the treatment of symptomatic osteoporotic vertebral fractures that are less than 6 weeks in duration that have led to hospitalization or persist at a level that prevents ambulation.

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 sacral lesions due to metastatic malignancies or multiple myeloma.

Medicare HMO BlueSM and Medicare PPO BlueSM Members

Medical necessity criteria and coding guidance for **Medicare Advantage members living in Massachusetts** can be found through the link(s) below.

[Local Coverage Determinations \(LCDs\) for National Government Services, Inc.](#)

Local Coverage Determination (LCD): Vertebroplasty and Vertebral Augmentation (Percutaneous) (L33569)

Note: To review the specific LCD, please remember to click “accept” on the CMS licensing agreement at the bottom of the CMS webpage.

For medical necessity criteria and coding guidance for **Medicare Advantage members living outside of Massachusetts**, please see the Centers for Medicare and Medicaid Services website at <https://www.cms.gov> for information regarding your specific jurisdiction.

Prior Authorization Information

Inpatient

- For services described in this policy, precertification/preauthorization **IS REQUIRED** for all products if the procedure is performed **inpatient**.

Outpatient

- For services described in this policy, see below for products where prior authorization **might be required** if the procedure is performed **outpatient**.

	Outpatient
Commercial Managed Care (HMO and POS)	Prior authorization is required .
Commercial PPO and Indemnity	Prior authorization is not required .
Medicare HMO Blue SM	Prior authorization is required .
Medicare PPO Blue SM	Prior authorization is not required .

CPT Codes / HCPCS Codes / ICD Codes

Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member’s contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member

Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.

The following codes are included below for informational purposes only; this is not an all-inclusive list.

The above **medical necessity criteria MUST** be met for the following codes to be covered for **Commercial Members: Managed Care (HMO and POS), PPO and Indemnity:**

CPT Codes

CPT codes:	Code Description
22510	Percutaneous vertebroplasty (bone biopsy included when performed), 1 vertebral body, unilateral or bilateral injection, inclusive of all imaging guidance; cervicothoracic
22511	Percutaneous vertebroplasty (bone biopsy included when performed), 1 vertebral body, unilateral or bilateral injection, inclusive of all imaging guidance; lumbosacral

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

ICD-10 Procedure Codes

ICD-10-PCS procedure codes:	Code Description
0PU33JZ	Supplement Cervical Vertebra with Synthetic Substitute, Percutaneous Approach
0PS33ZZ	Reposition Cervical Vertebra, Percutaneous Approach
0PS43ZZ	Reposition Thoracic Vertebra, Percutaneous Approach
0PU34JZ	Supplement Cervical Vertebra with Synthetic Substitute, Percutaneous Endoscopic Approach
0PU43JZ	Supplement Thoracic Vertebra with Synthetic Substitute, Percutaneous Approach
0PU44JZ	Supplement Thoracic Vertebra with Synthetic Substitute, Percutaneous Endoscopic Approach
0QS03ZZ	Reposition Lumbar Vertebra, Percutaneous Approach
0QS13ZZ	Reposition Sacrum, Percutaneous Approach
0QSS3ZZ	Reposition Coccyx, Percutaneous Approach
0QU03JZ	Supplement Lumbar Vertebra with Synthetic Substitute, Percutaneous Approach
0QU04JZ	Supplement Lumbar Vertebra with Synthetic Substitute, Percutaneous Endoscopic Approach
0QU13JZ	Supplement Sacrum with Synthetic Substitute, Percutaneous Approach
0QU14JZ	Supplement Sacrum with Synthetic Substitute, Percutaneous Endoscopic Approach
0QUS3JZ	Supplement Coccyx with Synthetic Substitute, Percutaneous Approach

The following ICD Diagnosis Codes are considered medically necessary when submitted with the CPT and/or ICD Procedure codes above if medical necessity criteria are met:

ICD-10 Diagnosis Codes

ICD-10-CM Diagnosis codes:	Code Description
C41.2	Malignant neoplasm of vertebral column
C79.51	Secondary malignant neoplasm of bone
C79.52	Secondary malignant neoplasm of bone marrow
C90.00	Multiple myeloma not having achieved remission
C90.01	Multiple myeloma in remission
C90.02	Multiple myeloma in relapse
D18.09	Hemangioma of other sites
D47.Z9	Other specified neoplasms of uncertain behavior of lymphoid, hematopoietic and related tissue
G89.3	Neoplasm related pain (acute) (chronic)
M48.50xA	Collapsed vertebra, not elsewhere classified, site unspecified, initial encounter for fracture
M48.50xD	Collapsed vertebra, not elsewhere classified, site unspecified, subsequent encounter for fracture with routine healing
M48.50xG	Collapsed vertebra, not elsewhere classified, site unspecified, subsequent encounter for fracture with delayed healing
M48.50xS	Collapsed vertebra, not elsewhere classified, site unspecified, sequela of fracture
M48.51xA	Collapsed vertebra, not elsewhere classified, occipito-atlanto-axial region, initial encounter for fracture

M48.51xD	Collapsed vertebra, not elsewhere classified, occipito-atlanto-axial region, subsequent encounter for fracture with routine healing
M48.51xG	Collapsed vertebra, not elsewhere classified, occipito-atlanto-axial region, subsequent encounter for fracture with delayed healing
M48.51xS	Collapsed vertebra, not elsewhere classified, occipito-atlanto-axial region, sequela of fracture
M48.52xA	Collapsed vertebra, not elsewhere classified, cervical region, initial encounter for fracture
M48.52xD	Collapsed vertebra, not elsewhere classified, cervical region, subsequent encounter for fracture with routine healing
M48.52xG	Collapsed vertebra, not elsewhere classified, cervical region, subsequent encounter for fracture with delayed healing
M48.52xS	Collapsed vertebra, not elsewhere classified, cervical region, sequela of fracture
M48.53xA	Collapsed vertebra, not elsewhere classified, cervicothoracic region, initial encounter for fracture
M48.53xD	Collapsed vertebra, not elsewhere classified, cervicothoracic region, subsequent encounter for fracture with routine healing
M48.53xG	Collapsed vertebra, not elsewhere classified, cervicothoracic region, subsequent encounter for fracture with delayed healing
M48.53xS	Collapsed vertebra, not elsewhere classified, cervicothoracic region, sequela of fracture
M48.54xA	Collapsed vertebra, not elsewhere classified, thoracic region, initial encounter for fracture
M48.54xD	Collapsed vertebra, not elsewhere classified, thoracic region, subsequent encounter for fracture with routine healing
M48.54xG	Collapsed vertebra, not elsewhere classified, thoracic region, subsequent encounter for fracture with delayed healing
M48.54xS	Collapsed vertebra, not elsewhere classified, thoracic region, sequela of fracture
M48.55xA	Collapsed vertebra, not elsewhere classified, thoracolumbar region, initial encounter for fracture
M48.55xD	Collapsed vertebra, not elsewhere classified, thoracolumbar region, subsequent encounter for fracture with routine healing
M48.55xG	Collapsed vertebra, not elsewhere classified, thoracolumbar region, subsequent encounter for fracture with delayed healing
M48.55xS	Collapsed vertebra, not elsewhere classified, thoracolumbar region, sequela of fracture
M48.56xA	Collapsed vertebra, not elsewhere classified, lumbar region, initial encounter for fracture
M48.56xD	Collapsed vertebra, not elsewhere classified, lumbar region, subsequent encounter for fracture with routine healing
M48.56xG	Collapsed vertebra, not elsewhere classified, lumbar region, subsequent encounter for fracture with delayed healing
M48.56xS	Collapsed vertebra, not elsewhere classified, lumbar region, sequela of fracture
M48.57xA	Collapsed vertebra, not elsewhere classified, lumbosacral region, initial encounter for fracture
M48.57xD	Collapsed vertebra, not elsewhere classified, lumbosacral region, subsequent encounter for fracture with routine healing
M48.57xG	Collapsed vertebra, not elsewhere classified, lumbosacral region, subsequent encounter for fracture with delayed healing
M48.57xS	Collapsed vertebra, not elsewhere classified, lumbosacral region, sequela of fracture
M48.58xA	Collapsed vertebra, not elsewhere classified, sacral and sacrococcygeal region, initial encounter for fracture
M48.58xD	Collapsed vertebra, not elsewhere classified, sacral and sacrococcygeal region, subsequent encounter for fracture with routine healing

M48.58xG	Collapsed vertebra, not elsewhere classified, sacral and sacrococcygeal region, subsequent encounter for fracture with delayed healing
M48.58xS	Collapsed vertebra, not elsewhere classified, sacral and sacrococcygeal region, sequela of fracture
M80.08xA	Age-related osteoporosis with current pathological fracture, vertebra(e), initial encounter for fracture
M80.08xD	Age-related osteoporosis with current pathological fracture, vertebra(e), subsequent encounter for fracture with routine healing
M80.08xG	Age-related osteoporosis with current pathological fracture, vertebra(e), subsequent encounter for fracture with delayed healing
M80.08xK	Age-related osteoporosis with current pathological fracture, vertebra(e), subsequent encounter for fracture with nonunion
M80.08xP	Age-related osteoporosis with current pathological fracture, vertebra(e), subsequent encounter for fracture with malunion
M80.08xS	Age-related osteoporosis with current pathological fracture, vertebra(e), sequela
M80.88xA	Other osteoporosis with current pathological fracture, vertebra(e), initial encounter for fracture
M80.88xD	Other osteoporosis with current pathological fracture, vertebra(e), subsequent encounter for fracture with routine healing
M80.88xG	Other osteoporosis with current pathological fracture, vertebra(e), subsequent encounter for fracture with delayed healing
M80.88xK	Other osteoporosis with current pathological fracture, vertebra(e), subsequent encounter for fracture with nonunion
M80.88xP	Other osteoporosis with current pathological fracture, vertebra(e), subsequent encounter for fracture with malunion
M80.88xS	Other osteoporosis with current pathological fracture, vertebra(e), sequela
M84.48xA	Pathological fracture, other site, initial encounter for fracture
M84.48xD	Pathological fracture, other site, subsequent encounter for fracture with routine healing
M84.48xG	Pathological fracture, other site, subsequent encounter for fracture with delayed healing
M84.48xK	Pathological fracture, other site, subsequent encounter for fracture with nonunion
M84.48xP	Pathological fracture, other site, subsequent encounter for fracture with malunion
M84.48xS	Pathological fracture, other site, sequela
M84.58xA	Pathological fracture in neoplastic disease, other specified site, initial encounter for fracture
M84.58xD	Pathological fracture in neoplastic disease, other specified site, subsequent encounter for fracture with routine healing
M84.58xG	Pathological fracture in neoplastic disease, other specified site, subsequent encounter for fracture with delayed healing
M84.58xK	Pathological fracture in neoplastic disease, other specified site, subsequent encounter for fracture with nonunion
M84.58xP	Pathological fracture in neoplastic disease, other specified site, subsequent encounter for fracture with malunion
M84.58xS	Pathological fracture in neoplastic disease, other specified site, sequela
M84.68xA	Pathological fracture in other disease, other site, initial encounter for fracture
M84.68xD	Pathological fracture in other disease, other site, subsequent encounter for fracture with routine healing
M84.68xG	Pathological fracture in other disease, other site, subsequent encounter for fracture with delayed healing
M84.68xK	Pathological fracture in other disease, other site, subsequent encounter for fracture with nonunion
M84.68xP	Pathological fracture in other disease, other site, subsequent encounter for fracture with malunion

M84.68xS	Pathological fracture in other disease, other site, sequela
----------	---

The following CPT codes are considered investigational for **Commercial Members: Managed Care (HMO and POS), PPO, Indemnity, Medicare HMO Blue and Medicare PPO Blue:**

CPT Codes

CPT codes:	Code Description
0200T	Percutaneous sacral augmentation (sacroplasty), unilateral injection(s), including the use of a balloon or mechanical device, when used, 1 or more needles
0201T	Percutaneous sacral augmentation (sacroplasty), bilateral injections, including the use of a balloon or mechanical device, when used, 2 or more needles

Description

Treatment of Vertebral Compression Fracture

Chronic symptoms do not tend to respond to the management strategies for acute pain such as bed rest, immobilization or 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 does not improve with analgesics and may be better addressed through exercise or physical therapy. Improvements in pain and ability to function are the principal outcomes of interest for treatment of osteoporotic fractures.

Treatment of Sacral Insufficiency Fractures

Similar interventions are used for sacral and vertebral fractures and include bed rest, bracing, and analgesics. Initial clinical improvements may occur quickly; however, resolution of all symptoms may not occur for 9 to 12 months.^{1,2}

Vertebral and Sacral Body Metastasis

Metastatic malignant disease of the spine generally involves the vertebrae/sacrum, with pain being the most frequent complaint.

Treatment of Vertebral and Sacral Body Metastasis

While radiotherapy 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. Improvements in pain and function are the primary outcomes of interest for treatment of bone malignancy with percutaneous vertebroplasty or sacroplasty.

Surgical Treatment Options

Percutaneous Vertebroplasty

Vertebroplasty is a surgical procedure that involves the injection of synthetic cement (eg, polymethylmethacrylate, bis-glycidyl dimethacrylate [Cortoss]³) into a fractured vertebra. It has been suggested that vertebroplasty may provide an analgesic effect through mechanical stabilization of a fractured or otherwise weakened vertebral body. However, other mechanisms of effect have been postulated, including thermal damage to intraosseous nerve fibers.

Percutaneous Sacroplasty

Sacroplasty evolved from the treatment of insufficiency fractures in the thoracic and lumbar vertebrae with vertebroplasty. The procedure, essentially identical to vertebroplasty, entails guided injection of polymethylmethacrylate through a needle inserted into the fracture zone. Although first described in 2000 as a treatment for symptomatic sacral metastatic lesions,^{4,5} it is most often described as a minimally invasive alternative to conservative management^{6,7,8} for sacral insufficiency fractures.

Pain and function are subjective outcomes and, thus, may be susceptible to placebo effects. Furthermore, the natural history of pain and disability associated with these conditions may vary. 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 events 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 polymethyl methacrylate or another injectate.

Summary

Percutaneous vertebroplasty is an interventional technique involving the fluoroscopically guided injection of polymethyl methacrylate into a weakened vertebral body. The technique has been investigated to provide mechanical support and symptomatic relief in patients with osteoporotic vertebral compression fractures or those with osteolytic lesions of the spine (eg, multiple myeloma, metastatic malignancies); as a treatment for sacral insufficiency fractures; and as a technique to limit blood loss related to surgery.

For individuals who have symptomatic osteoporotic vertebral fractures between 6 weeks and 1 year old who receive vertebroplasty, the evidence includes 2 randomized sham-controlled trials, nonblinded randomized controlled trials (RCTs) comparing vertebroplasty with conservative management, and systematic reviews of these RCTs. Relevant outcomes are symptoms, functional outcomes, quality of life, hospitalizations, medication use, and treatment-related morbidity. Despite the completion of multiple RCTs, including 2 with sham controls, the efficacy of vertebroplasty for painful osteoporotic compression fractures remains uncertain. Two meta-analysis studies which included the 2 sham-controlled trials have demonstrated mixed results. The 2 studies had methodologic issues, including the choice of sham procedure and the potential of the sham procedure to have a therapeutic effect by reducing pain. Questions have also been raised about the low percentage of patients screened who participated in the trial, the volume of polymethylmethacrylate injected, and the inclusion of patients with chronic pain. Overall, conclusions about the effect of vertebroplasty remain unclear. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals with symptomatic osteoporotic vertebral fractures less than 6 weeks old who receive vertebroplasty, the evidence includes a randomized sham-controlled trial and nonblinded RCTs comparing vertebroplasty with conservative management. Relevant outcomes are symptoms, functional outcomes, quality of life, hospitalizations, medication use, and treatment-related morbidity. 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. However, a sham-controlled randomized trial in patients who had severe pain of fewer than 6 weeks in duration found a significant benefit of vertebroplasty for the treatment of osteoporotic vertebral fracture at the thoracolumbar junction. Other RCTs without sham controls have reported that vertebroplasty is associated with significant improvements in pain and reductions in the duration of bed rest. Given the high morbidity associated with extended bed rest in older adults, this procedure is considered to have a significant health benefit. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals with sacral insufficiency fractures who receive sacroplasty, the evidence includes 2 prospective cohort studies and a case series. Relevant outcomes are symptoms, functional outcomes, quality of life, hospitalizations, medication use, and treatment-related morbidity. No RCTs have been reported. The available evidence includes a prospective cohort study and a retrospective series of 243 patients. These studies have reported rapid and sustained decreases in pain following percutaneous sacroplasty. Additional literature has mostly reported immediate improvements following the procedure. However, due to the small size of the evidence base, the harms associated with sacroplasty have not been adequately studied. The evidence is insufficient to determine the effects of the technology on health outcomes.

Vertebroplasty has been investigated as an intervention to provide mechanical support and symptomatic relief in patients with an osteoporotic vertebral compression fracture and in those with osteolytic lesions of the spine (ie, multiple myeloma, metastatic malignancies). Clinical input obtained in 2008 provided uniform support for the use of vertebroplasty in painful osteoporotic fractures. Reconsideration of the available evidence and evaluation of the input led to a conclusion that, consistent results of numerous case series, including large prospective reports, the evidence was sufficient to determine that vertebroplasty is a reasonable treatment option in patients with vertebral fractures who have failed to respond to conservative treatment (at least 6 weeks with analgesics, physical therapy, and rest). It is also clinically reasonable to consider the evidence supporting the clinical benefit of vertebroplasty in the osteoporotic vertebral fracture to support its use in osteolytic lesions of the spine (eg, multiple myeloma, metastatic malignancies).

Policy History

Date	Action
6/2020	BCBSA National medical policy review. Description, summary and references updated. Policy statements unchanged.
5/2019	BCBSA National medical policy review. Description, summary and references updated. Policy statements unchanged.
5/2018	New references added from BCBSA National medical policy. Summary clarified.
10/2017	BCBSA National medical policy review. New medically necessary indications described. Effective 10/1/2017.
9/2016	BCBSA National medical policy review. "Spinal lesions" in 3rd policy statement changed to "sacral lesions" to clarify the intent. References added.
1/2016	Clarified coding information.
6/2015	New references added from BCBSA National medical policy.
1/2015	Clarified coding information.
7/2014	New references added from BCBSA National medical policy.
6/2014	Updated Coding section with ICD10 procedure and diagnosis codes. Effective 10/2015.
2/2014	Local Coverage Determination (LCD) for Percutaneous Vertebroplasty/Percutaneous Augmentation (L11417) retired and replaced by LCD L26439 Vertebroplasty and Vertebral Augmentation (Percutaneous). Effective October 25, 2013.
6/2013	New references from BCBSA National medical policy.
11/2011-4/2012	Medical policy ICD 10 remediation: Formatting, editing and coding updates. No changes to policy statements.
1/2012	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy statements.
12/1/2011	BCBSA National medical policy review. Changes to policy statements.
1/2011	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy statements.
7/2010	Reviewed - Medical Policy Group - Orthopedics, Rehabilitation Medicine and Rheumatology. No changes to policy statements.
6/2010	BCBSA National medical policy review. Changes to policy statements.
1/2010	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy statements.
7/2009	Reviewed - Medical Policy Group - Orthopedics, Rehabilitation Medicine and Rheumatology. No changes to policy statements.
6/1/2009	New policy, effective 6/1/2009, describing covered and non-covered indications.
11/2008	BCBSA National medical policy review. No changes to policy statements.
7/2008	Reviewed - Medical Policy Group - Orthopedics, Rehabilitation Medicine and Rheumatology. No changes to policy statements.
1/2008	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy statements.
1/2007	Reviewed - Medical Policy Group - Neurology and Neurosurgery. No changes to policy statements.

Information Pertaining to All Blue Cross Blue Shield Medical Policies

Click on any of the following terms to access the relevant information:

[Medical Policy Terms of Use](#)

[Managed Care Guidelines](#)

[Indemnity/PPO Guidelines](#)

[Clinical Exception Process](#)

[Medical Technology Assessment Guidelines](#)

References

1. Gotis-Graham I, McGuigan L, Diamond T, et al. Sacral insufficiency fractures in the elderly. *J Bone Joint Surg Br.* Nov 1994;76(6):882-886. PMID 7983111
2. Lin J, Lachmann E, Nagler W. Sacral insufficiency fractures: a report of two cases and a review of the literature. *J Womens Health Gen Based Med.* Sep 2001;10(7):699-705. PMID 11571100
3. Bae H, Hatten HP, Jr., Linovitz R, et al. A prospective randomized FDA-IDE trial comparing Cortoss with PMMA for vertebroplasty: a comparative effectiveness research study with 24-month follow-up. *Spine (Phila Pa 1976).* Apr 1 2012;37(7):544-550. PMID 21738093
4. Dehdashti AR, Martin JB, Jean B, et al. PMMA cementoplasty in symptomatic metastatic lesions of the S1 vertebral body. *Cardiovasc Intervent Radiol.* May-Jun 2000;23(3):235-237. PMID 10821903
5. Marcy PY, Palussiere J, Descamps B, et al. Percutaneous cementoplasty for pelvic bone metastasis. *Support Care Cancer.* Nov 2000;8(6):500-503. PMID 11094996
6. Aretxabala I, Fraiz E, Perez-Ruiz F, et al. Sacral insufficiency fractures. High association with pubic rami fractures. *Clin Rheumatol.* Oct 2000;19(5):399-401. PMID 11055834
7. Leroux JL, Denat B, Thomas E, et al. Sacral insufficiency fractures presenting as acute low-back pain. Biomechanical aspects. *Spine (Phila Pa 1976).* Dec 1993;18(16):2502-2506. PMID 8303454
8. Newhouse KE, el-Khoury GY, Buckwalter JA. Occult sacral fractures in osteopenic patients. *J Bone Joint Surg Am.* Dec 1992;74(10):1472-1477. PMID 1364816
9. Stratford PW, Binkley J, Solomon P, et al. Defining the minimum level of detectable change for the Roland-Morris questionnaire. *Phys Ther.* 1996 Apr;76(4):359-65. PMID: 8606899
10. Katz J, Melzack R. Measurement of pain. *Surg Clin North Am.* 1999 Apr;79(2):231-52. PMID: 10352653
11. Blue Cross and Blue Shield Technology Evaluation Center (TEC). Percutaneous Vertebroplasty. TEC Assessments. 2000;Volume 15:Tab 21.
12. Blue Cross and Blue Shield Technology Evaluation Center (TEC). Percutaneous vertebroplasty for vertebral fractures caused by osteoporosis, malignancy, or hemangioma. TEC Assessments. 2004;Volume 19:Tab 13.
13. Blue Cross and Blue Shield Technology Evaluation Center (TEC). Percutaneous vertebroplasty for vertebral fractures caused by osteoporosis or malignancy. TEC Assessments. 2005;Volume 20:Tab 6.
14. Blue Cross and Blue Shield Technology Evaluation Center (TEC). Percutaneous vertebroplasty or kyphoplasty for vertebral fractures caused by osteoporosis or malignancy. TEC Assessments. 2008;Volume 23:Tab 5.
15. Blue Cross and Blue Shield Technology Evaluation Center (TEC). Percutaneous vertebroplasty or kyphoplasty for vertebral fractures caused by osteoporosis. TEC Assessments. 2009;Volume 24:Tab 7.
16. Blue Cross and Blue Shield Technology Evaluation Center (TEC). Percutaneous vertebroplasty for vertebral fractures caused by osteoporosis. TEC Assessments. 2010;Volume 25:Tab 9.
17. Buchbinder R, Johnston RV, Rischin KJ, et al. Percutaneous vertebroplasty for osteoporotic vertebral compression fracture. *Cochrane Database Syst Rev.* 2018 Apr 4;4:CD006349. PMID: 29618171
18. Staples MP, Kallmes DF, Comstock BA, et al. Effectiveness of vertebroplasty using individual patient data from two randomised placebo controlled trials: meta-analysis. *BMJ.* Jul 12 2011;343:d3952. PMID 21750078
19. Xie L, Zhao ZG, Zhang SJ, et al. Percutaneous vertebroplasty versus conservative treatment for osteoporotic vertebral compression fractures: An updated meta-analysis of prospective randomized controlled trials. *Int J Surg.* Nov 2017;47:25-32. PMID 28939236
20. Buchbinder R, Osborne RH, Ebeling PR, et al. A randomized trial of vertebroplasty for painful osteoporotic vertebral fractures. *N Engl J Med.* Aug 6 2009;361(6):557-568. PMID 19657121

21. Kallmes DF, Comstock BA, Heagerty PJ, et al. A randomized trial of vertebroplasty for osteoporotic spinal fractures. *N Engl J Med*. Aug 6 2009;361(6):569-579. PMID 19657122
22. Kroon F, Staples M, Ebeling PR, et al. Two-year results of a randomized placebo-controlled trial of vertebroplasty for acute osteoporotic vertebral fractures. *J Bone Miner Res*. Jun 2014;29(6):1346-1355. PMID 24967454
23. Ostelo RW, Deyo RA, Stratford P, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. *Spine (Phila Pa 1976)*. Jan 1 2008;33(1):90-94. PMID 18165753
24. Comstock BA, Sitlani CM, Jarvik JG, et al. Investigational vertebroplasty safety and efficacy trial (INVEST): patient-reported outcomes through 1 year. *Radiology*. Oct 2013;269(1):224-231. PMID 23696683
25. Firanescu CE, de Vries J, Lodder P, et al. Vertebroplasty versus sham procedure for painful acute osteoporotic vertebral compression fractures (VERTOS IV): randomised sham controlled clinical trial. *BMJ*. 2018 May 9;361:k1551. PMID: 29743284
26. Chen D, An ZQ, Song S, et al. Percutaneous vertebroplasty compared with conservative treatment in patients with chronic painful osteoporotic spinal fractures. *J Clin Neurosci*. Mar 2014;21(3):473-477. PMID 24315046
27. Farrokhi MR, Alibai E, Maghami Z. Randomized controlled trial of percutaneous vertebroplasty versus optimal medical management for the relief of pain and disability in acute osteoporotic vertebral compression fractures. *J Neurosurg Spine*. May 2011;14(5):561-569. PMID 21375382
28. Edidin AA, Ong KL, Lau E, et al. Mortality risk for operated and nonoperated vertebral fracture patients in the Medicare population. *J Bone Miner Res*. Jul 2011;26(7):1617-1626. PMID 21308780
29. Edidin AA, Ong KL, Lau E, et al. Morbidity and mortality after vertebral fractures: comparison of vertebral augmentation and nonoperative management in the Medicare population. *Spine (Phila Pa 1976)*. Aug 01 2015;40(15):1228-1241. PMID 26020845
30. Lin JH, Chien LN, Tsai WL, et al. Early vertebroplasty associated with a lower risk of mortality and respiratory failure in aged patients with painful vertebral compression fractures: a population-based cohort study in Taiwan. *Spine J*. Sep 2017;17(9):1310-1318. PMID 28483705
31. Clark W, Bird P, Gonski P, et al. Safety and efficacy of vertebroplasty for acute painful osteoporotic fractures (VAPOUR): a multicentre, randomised, double-blind, placebo-controlled trial. *Lancet*. Oct 01 2016;388(10052):1408-1416. PMID 27544377
32. Klazen CA, Lohle PN, de Vries J, et al. Vertebroplasty versus conservative treatment in acute osteoporotic vertebral compression fractures (Vertos II): an open-label randomised trial. *Lancet*. Sep 25 2010;376(9746):1085-1092. PMID 20701962
33. Yi X, Lu H, Tian F, et al. Recompression in new levels after percutaneous vertebroplasty and kyphoplasty compared with conservative treatment. *Arch Orthop Trauma Surg*. Jan 2014;134(1):21-30. PMID 24287674
34. Leali PT, Solla F, Maestretti G, et al. Safety and efficacy of vertebroplasty in the treatment of osteoporotic vertebral compression fractures: a prospective multicenter international randomized controlled study. *Clin Cases Miner Bone Metab*. Sep-Dec 2016;13(3):234-236. PMID 28228788
35. Yang EZ, Xu JG, Huang GZ, et al. Percutaneous Vertebroplasty versus conservative treatment in aged patients with acute osteoporotic vertebral compression fractures: a prospective randomized controlled clinical study. *Spine (Phila Pa 1976)*. Apr 2016;41(8):653-660. PMID 26630417
36. Lourie H. Spontaneous osteoporotic fracture of the sacrum. An unrecognized syndrome of the elderly. *JAMA*. Aug 13 1982;248(6):715-717. PMID 7097924
37. Frey ME, Depalma MJ, Cifu DX, et al. Percutaneous sacroplasty for osteoporotic sacral insufficiency fractures: a prospective, multicenter, observational pilot study. *Spine J*. Mar-Apr 2008;8(2):367-373. PMID 17981097
38. Kortman K, Ortiz O, Miller T, et al. Multicenter study to assess the efficacy and safety of sacroplasty in patients with osteoporotic sacral insufficiency fractures or pathologic sacral lesions. *J Neurointerv Surg*. Sep 1 2013;5(5):461-466. PMID 22684691
39. Frey ME, Warner C, Thomas SM, et al. Sacroplasty: a ten-year analysis of prospective patients treated with percutaneous sacroplasty: literature review and technical considerations. *Pain Physician*. Nov 2017;20(7):E1063- E1072. PMID 29149151
40. Dougherty RW, McDonald JS, Cho YW, et al. Percutaneous sacroplasty using CT guidance for pain palliation in sacral insufficiency fractures. *J Neurointerv Surg*. Jan 2014;6(1):57-60. PMID 23345629

41. Zaman FM, Frey M, Slipman CW. Sacral stress fractures. *Curr Sports Med Rep*. Feb 2006;5(1):37-43. PMID 16483515
42. Denis F, Davis S, Comfort T. Sacral fractures: an important problem. Retrospective analysis of 236 cases. *Clin Orthop Relat Res*. Feb 1988;227:67-81. PMID 3338224
43. Shah LM, Jennings JW, Kirsch CFE et al. ACR Appropriateness Criteria^(R) Management of Vertebral Compression Fractures. *J Am Coll Radiol*. 2018 Nov;15(11S). PMID 30392604
44. Barr JD, Jensen ME, Hirsch JA, et al. Position statement on percutaneous vertebral augmentation: a consensus statement developed by the Society of Interventional Radiology (SIR), American Association of Neurological Surgeons (AANS) and the Congress of Neurological Surgeons (CNS), American College of Radiology (ACR), American Society of Neuroradiology (ASNR), American Society of Spine Radiology (ASSR), Canadian Interventional Radiology Association (CIRA), and the Society of NeuroInterventional Surgery (SNIS). *J Vasc Interv Radiol*. 2014 Feb;25(2):171-81. PMID: 24325929.
45. Baerlocher MO, Saad WE, Dariushnia S, et al. Quality improvement guidelines for percutaneous vertebroplasty. *J Vasc Interv Radiol*. Feb 2014;25(2):165-170. PMID 24238815
46. McGuire R. AAOS Clinical Practice Guideline: the Treatment of Symptomatic Osteoporotic Spinal Compression Fractures. *J Am Acad Orthop Surg*. 2011 Mar;19(3). PMID 21368100
47. National Institute for Health and Care Excellence (NICE). Percutaneous vertebroplasty [IPG12]. 2003; <https://www.nice.org.uk/guidance/ipg12>. Accessed March 18, 2020.
48. National Institute for Health and Care Excellence (NICE). Percutaneous vertebroplasty and percutaneous balloon kyphoplasty for treating osteoporotic vertebral compression fractures [TA279]. 2013; <https://www.nice.org.uk/guidance/ta279>. Accessed March 18, 2020.
49. National Institute for Health and Care Excellence (NICE). Metastatic spinal cord compression in adults: risk assessment, diagnosis and management [CG75]. 2008; <https://www.nice.org.uk/guidance/cg75/chapter/1-guidance>. Accessed March 18, 2020.

Endnotes

¹ Based on expert opinion