CLINICAL GUIDELINES

CMM-607: Primary Vertebral Augmentation (Percutaneous Vertebroplasty/Kyphoplasty) and Sacroplasty Guidelines

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eviCore healthcare Clinical Decision Support Tool Diagnostic Strategies: This tool addresses common symptoms and symptom complexes. Requests for individuals with atypical symptoms or clinical presentations that are not specifically addressed will require physician review. Consultation with the referring physician, specialist and/or individual's Primary Care Physician (PCP) may provide additional insight.

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Clinical guidelines for medical necessity review of Comprehensive Musculoskeletal Management Services.

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CMM-607: Primary Vertebral Augmentation (Percutaneous Vertebroplasty/Kyphoplasty) and Sacroplasty

CMM-607.1: General Guidelines
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CMM-607.4: Procedure (CPT®) Codes
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CMM-607.1: General Guidelines

Application of Guideline

- The determination of medical necessity for the performance of vertebral augmentation (percutaneous vertebroplasty/kyphoplasty) and sacroplasty is always made on a case-by-case basis.
- For prior authorization requirements, see **CMM-600.1: Prior Authorization Requirements**.

Urgent/Emergent Indications/Conditions

- The presence of urgent/emergent indications/conditions warrants definitive surgical treatment. Confirmatory advanced imaging studies are required. The following criteria are **NOT** required for confirmed urgent/emergent conditions:
  - Provider-directed non-surgical management
- Urgent/emergent conditions for vertebral augmentation procedure include **EITHER** of the following:
  - Primary or metastatic neoplastic disease causing pathologic fracture
  - Documentation of severe debilitating or crippling pain and/or dysfunction to the point of being incapacitated

Credentialed Spine Surgeon Available

- A vertebral augmentation (percutaneous vertebroplasty/kyphoplasty) should only be performed when there is credentialed spine surgeon available to perform an urgent laminectomy in the event of cement extravasation into the spinal canal

CMM-607.2: Indications

Vertebral augmentation (injection of methylmethacrylate cement under imaging guidance) is considered **medically necessary** for **ANY** of the following when **ALL** of the associated criteria are met:

Associated Surgical Procedure

- Performed for pre-surgical stabilization of a vertebral body to facilitate a fusion operation
- Performed at no more than 2 levels of the T5-L5 spine on the same date of service

Malignant Conditions

- Recent (within 6 months) concordant imaging confirms **ANY** of the following:
  - Osteolytic metastases including destruction of a vertebral body by multiple myeloma
  - Primary malignant neoplasm of bone or bone marrow

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- Performed at no more than 2 levels of the T5-L5 spine on the same date of service
- Persistent pain including **BOTH** of the following:
  - Significant level of pain on a daily basis defined as **EITHER** of the following:
    - Visual Analog Scale (VAS)/Number Rating Scale (NRS) ≥ 7
    - Pain described as severe
  - Clinically significant functional impairment (e.g. inability to perform household chores, prolonged standing, or essential job functions)
- **EITHER** of the following:
  - Acute (0-6 weeks) axial pain in the thoracic/lumbar spine that persists at a level which prevents independent transfers and/or ambulation and correlates with the level of the fracture
  - Subacute (> 6 weeks) axial pain in the thoracic/lumbar spine with less than clinically meaningful improvement with **BOTH** of the following (unless contraindicated):
    - Prescription strength analgesics, steroids, and/or NSAIDs for 4 weeks
    - Provider-directed exercise program prescribed by a physical therapist, chiropractic provider, osteopathic or allopathic physician for 4 weeks

Non-Malignant Conditions

- Recent (within 6 months) concordant imaging confirms **ANY** of the following:
  - Osteolytic or osteoporotic vertebral compression fracture
  - Aggressive space occupying lesions of a vertebral body (hemangioma/eosinophilic granuloma)
  - Osteonecrotic (i.e., Kummel disease) vertebral compression fracture
  - Steroid induced vertebral compression fracture
- Performed at no more than 2 levels of the T5-L5 spine on the same date of service
- Persistent pain including **BOTH** of the following:
  - Significant level of pain on a daily basis defined as **EITHER** of the following:
    - Visual Analog Scale (VAS)/Number Rating Scale (NRS) ≥ 7
    - Pain described as severe
  - Clinically significant functional impairment (e.g. inability to perform household chores, prolonged standing or essential job functions)
- **EITHER** of the following:
  - Acute (0-6 weeks) axial pain in the thoracic/lumbar spine that persists at a level which prevents independent transfers and/or ambulation and correlates with the level of the fracture
  - Subacute (> 6 weeks) axial pain in the thoracic/lumbar spine with less than clinically meaningful improvement with **BOTH** of the following (unless contraindicated):
    - Prescription strength analgesics, steroids, and/or NSAIDs for 4 weeks

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- Provider-directed exercise program prescribed by a physical therapist, chiropractic provider, osteopathic or allopathic physician for 4 weeks

CMM-607.3: Non-Indications

Not Medically Necessary

- Vertebral Augmentation (Percutaneous Vertebroplasty/Kyphoplasty) performed without meeting the requirements in the General Guidelines and Indications sections is considered **not medically necessary.**
- Vertebral Augmentation (Percutaneous Vertebroplasty/Kyphoplasty) is considered **not medically necessary** when there is presence of **ANY** of the following alternative causes of axial back pain:
  - Lumbar/thoracic radiculopathy or facet disease
  - Lumbar/thoracic/sacral trigger points
  - Sacral insufficiency fractures
- Vertebral Augmentation (Percutaneous Vertebroplasty/Kyphoplasty) considered **not medically necessary** when there is a presence of **ANY** of the following contraindications:
  - Allergy to materials used in the procedure
  - Uncorrected coagulation disorders or anticoagulation therapy
  - Myelopathy associated with a bone fragment in the spinal canal or cord compression from a tumor
  - Extensive vertebral destruction
  - Burst fracture associated with widened pedicles and/or retropulsed bone fragments
  - Potential space occupying lesions causing cord compression (tumor, bone fragment)
  - Collapse of vertebral body to less than the level of the vertebra plana
  - The use of Norian XR cement and Norian SRS cement products is prohibited because they are not FDA approved
  - Radiculopathy from a herniated intervertebral disc
  - Untreated symptomatic foraminal or canal stenosis, facet arthropathy, or other significant coexistent spinal or bony pain generators
  - Unstable fracture or requirement for stabilization procedure in the same or adjacent spinal region
  - Septicemia and any active infection (including urinary tract infection [UTI])
  - Active osteomyelitis of the target vertebra
  - Severe cardiopulmonary disease

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Experimental, Investigational, Unproven (EIU)

- Primary Vertebral Augmentation (Percutaneous Vertebroplasty/Kyphoplasty) is considered **experimental, investigational, or unproven (EIU)** for **EITHER** of the following:
  - Percutaneous vertebral augmentation for **ANY** of the following:
    - Non-painful/non-aggressive vertebral hemangioma
    - Vertebrae of the cervical spine and thoracic levels T1-T4
    - Stabilization of insufficiency fractures or lesions of the sacrum (sacroplasty) or coccyx (coccygeoplasty)
    - Prophylactic treatment for osteoporosis of the spine
    - Prophylactic treatment for chronic back pain of longstanding duration (>6 months), even if associated with old compression fracture(s)
  - Spinoplasty (e.g. OptiMesh® 1500E Polyethylene Terephthalate (PET) mesh pouch)

CMM-607.4: Procedure (CPT®) Codes

This guideline relates to the CPT® code set below. Codes are displayed for informational purposes only. Any given code's inclusion on this list does not necessarily indicate prior authorization is required.

CPT®	Code Description/Definitions
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)
22513	Percutaneous Vertebral Augmentation, Including Cavity Creation (Fracture Reduction and Bone Biopsy Included When Performed) Using Mechanical Device, (e.g. Kyphoplasty); 1 Vertebral Body, Unilateral or Bilateral Cannulation, Inclusive Of All Imaging Guidance; Thoracic
22514	Percutaneous Vertebral Augmentation, Including Cavity Creation (Fracture Reduction and Bone Biopsy Included When Performed) Using Mechanical Device, (e.g. Kyphoplasty); 1 Vertebral Body, Unilateral or Bilateral Cannulation, Inclusive Of All Imaging Guidance; Lumbar
+22515	Percutaneous Vertebral Augmentation, Including Cavity Creation (Fracture Reduction and Bone Biopsy Included When Performed) Using Mechanical Device, (e.g. Kyphoplasty); 1 Vertebral Body, Unilateral or Bilateral Cannulation, Inclusive Of All Imaging Guidance; Each Additional Thoracic or Lumbar Vertebral Body (List Separately in Addition to Code for Primary Procedure)

This list may not be all inclusive and is not intended to be used for coding/billing purposes. The final determination of reimbursement for services is the decision of the health plan and is based on the individual's policy or benefit entitlement structure as well as claims processing rules.

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CMM-607.5: References

1. American Academy of Orthopaedic Surgeons (AAOS). *The treatment of symptomatic osteoporotic spinal compression fractures*. September 24, 2010.
2. Abeloff: Abeloff's clinical oncology, 4th ed. Churchill Livingstone, an imprint of Elsevier; 2008.
3. ACR-ASNR-ASSR-SIR-SNIS Practice Parameter for the Performance of Vertebral Augmentation amended 2014.
4. Bayley E, et al. Clinical outcomes of sacroplasty in sacral insufficiency fractures: a review of the literature. *Eur Spine J*. 2009; 18:1266–1271.
5. Berenson J, Pflugmacher R, Jarzem P, Zonder J, Schechtman K, Tillman JB, et al.; Cancer Patient Fracture Evaluation (CAFE) Investigators. Balloon kyphoplasty versus non-surgical fracture management for treatment of painful vertebral body compression fractures in patients with cancer: a multicentre, randomised controlled trial. *Lancet Oncol*. 2011 Mar;12(3):225-35. Epub 2011 Feb 16.
6. BlueCross BlueShield Association (BCBSA) Technology Evaluation Center (TEC). Percutaneous vertebroplasty or kyphoplasty for vertebral fractures caused by osteoporosis TEC Assessment Program.
7. Boonen S, Van Meirhaeghe J, Bastian L, Cummings SR, Ranstam J, Tillman JB, Eastell R, et al. Balloon kyphoplasty for the treatment of acute vertebral compression fractures: 2-year results from a randomized trial. *J Bone Miner Res*. 2011 Jul;26(7):1627-37.
8. Bouza C, Lopez T, Magro A, Navalpotro L, Amate JM. Efficacy and safety of balloon kyphoplasty in the treatment of vertebral compression fractures: a systematic review. *Eur Spine J*. 2006 Jan 21:1-18.
9. Buchbinder R, Osborne RH, Ebeling PR, Wark JD, Mitchell P, Wriedt C, et al. randomized trial of vertebroplasty for painful osteoporotic vertebral fractures. *N Engl J Med*. 2009 Aug 6;361(6):557-68.
10. Chou R., Qaseem, A., Snow, V., et al. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Ann Intern Med*. 2007 Oct 2;147(7):478-491.
11. Clark W, Bird P, Gonski T, et al. Safety and efficacy of vertebroplasty for acute painful osteoporotic fractures (VAPOUR): a multicenter, randomized, double-blind, placebo-controlled trial. *Lancet*. 2016;388: 1408-16.
12. Coumans JVCE, Reinhardt MK, Lieberman IH. Kyphoplasty for vertebral compression fractures: 1-year clinical outcomes from a prospective study. *J Neurosurg*. 2003 Jul;99(1 Suppl):44-50.
13. De Negri P, Tirri T, Paternoster G, Modano P. Treatment of painful osteoporotic or traumatic vertebral compression fractures by percutaneous vertebral augmentation procedures: a nonrandomized comparison between vertebroplasty and kyphoplasty. *Clin J Pain*. 2007 Jun;23(5):425-30.
14. Deramond H, Saliou G, Aveillan M, Lehmann P, Vallee JN. Respective contributions of vertebroplasty and kyphoplasty to the management of osteoporotic vertebral fractures. *Joint Bone Spine*. 2006 Dec;73(6):610-3. Epub 2006 Oct 11.
15. Eck JC, Nachtigall D, Humphreys SC, Hodges SD. Comparison of vertebroplasty and balloon kyphoplasty for treatment of vertebral compression fractures: a meta-analysis of the literature. *Spine J*. 2008 May-Jun;8(3):488-97.
16. ECRI Institute. *Percutaneous kyphoplasty for the treatment of vertebral fractures*. Plymouth Meeting (PA): ECRI Institute Health Technology Assessment Information Service. 2006 Mar 75 p. (Windows on Medical Technology™, no. 132).
17. ECRI Institute. *Percutaneous vertebroplasty for the treatment of vertebral fractures*. Plymouth Meeting (PA): ECRI Institute Health Technology Assessment Information Service; 2008 Dec.
18. Eichholz KM, O'Toole JE, Christie SD, Fessler RG. Vertebroplasty and kyphoplasty. *Neurosurg Clin North Am*. 2006 Oct;17(4):507-18.
19. Esses SI, McGuire R, Jenkins J, Finkelstein J, Woodard E, Watters WC 3rd, et al. AAOS Clinical Practice Guideline: The Treatment of Symptomatic Osteoporotic Spinal Compression Fractures. *J Am Acad Orthop Surg*. 2011 Mar;19(3):183-4.
20. Farrokhi MR, Alibai E, Maghami Z. Randomized controlled trial of percutaneous vertebroplasty versus optimal medical management for the relief of pain and disability in acute osteoporotic vertebral compression fractures. *J Neurosurg Spine*. 2011 May;14(5):561-9. Epub 2011 Mar 4.
21. Feng L, Shen JM, Feng C, et al. Comparison of radiofrequency kyphoplasty (RFK) and balloon kyphoplasty (BKP) in the treatment of vertebral compression fractures: a meta-analysis. *Medicine*. 2017 Jun;96(25):e7150.
22. Frey ME, Depalma MJ, Cifu DX, Bhagia SM, Carne W, Daitch JS. Percutaneous sacroplasty for osteoporotic sacral insufficiency fractures: a prospective, multicenter, observational pilot study. *Spine J*. 2008 Mar-Apr;8(2):367-73. Epub 2007 Jul 20.
23. Frey ME, et al. Efficacy and safety of percutaneous sacroplasty for painful osteoporotic sacral insufficiency fractures. a prospective multi-center trial. *Spine*. 32(15):1635–1640.
24. Gaitanis IN, Hadjipavlou AG, Katonis PG, Tzermiadianos MN, Pasku DS, Patwardhan AG. Balloon kyphoplasty for the treatment of pathological vertebral compressive fractures. *Eur Spine J*. 2005 Apr;14(3):250-60. Epub 2004 Oct 8.

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25. Garfin SR, Buckley RA, Ledlie J, Balloon Kyphoplasty Outcomes Group. Balloon kyphoplasty for symptomatic vertebral body compression fractures results in rapid, significant, and sustained improvements in back pain, function, and quality of life for elderly patients. *Spine*. 2006 Sep 1;31(19):2213-20.
26. Grohs JG, Matzner M, Trieb K, Krepler P. Minimal invasive stabilization of osteoporotic vertebral fractures: a prospective nonrandomized comparison of vertebroplasty and balloon kyphoplasty. *J Spinal Disord Tech*. 2005 Jun;18(3):238-42.
27. Hadjipavlou AG, Tzermiadiamos MN, Katonis PG, Szpalski M. Percutaneous vertebroplasty and balloon kyphoplasty for the treatment of osteoporotic vertebral compression fractures and osteolytic tumours. *J Bone Joint Surg Br*. 2005 Dec;87(12):1595-604.
28. Haig A. J., Colwell, M. *Back Pain*. ACP Press; 2005.
29. Han S, Wan S, Ning L, Tong Y, Zhang J, Fan S. Percutaneous vertebroplasty versus balloon kyphoplasty for treatment of osteoporotic vertebral compression fracture: a meta-analysis of randomised and non-randomised controlled trials. *Int Orthop*. 2011 Sep;35(9):1349-58. Epub 2011 Jun 3.
30. Hulme PA, Krebs J, Ferguson SJ, Berlemann U. Vertebroplasty and kyphoplasty: a systematic review of clinical studies. *Spine*. 2006 Aug 1;31(17):1983-2001.
31. Institute for Clinical Systems Improvement (ICSI). Health Care Guideline: A*dult Acute and Subacute Low Back Pain*.15 ed. Bloomington (MN): Institute for Clinical Systems Improvement; January 2012. Accessed October 17,2012.
32. Institute for Clinical Systems Improvement (ICSI). (2004, January). *Vertebroplasty and balloon-assisted vertebroplasty for the treatment of osteoporotic compression fractures*. Technology Assessment Report #79. Retrieved 8/14/04 from
33. Jacobson RE, Palea O, Granville M. Progression of vertebral compression fractures after previous vertebral augmentation: technical reasons for recurrent fractures in a previously treated vertebra. *Cureus*. 2017 Oct 16;9(10):e1776. doi 10.7759/cureus.1776.
34. Kallmes DF, Comstock BA, Heagerty PJ, Turner JA, Wilson DJ, Diamond TH, et al. A randomized trial of vertebroplasty for osteoporotic spinal fractures. *N Engl J Med*. 2009 Aug 6;361(6):569-79.
35. Kasperk C, Grafe IA, Schmitt S, Nöldge G, Weiss C, Da Fonseca K, et al. Three-year outcomes after kyphoplasty in patients with osteoporosis with painful vertebral fractures. *J Vasc Interv Radiol*. 2010 May;21(5):701-9. Epub 2010 Mar 20.
36. Kasperk C, Hillmeier J, Noldge G, Grafe IA, DaFonseca K, Raupp D, et al. Treatment of painful vertebral fractures by kyphoplasty in patients with primary osteoporosis: a prospective nonrandomized controlled study. *J Bone Miner Res*. 2005 Apr;20(4):604-12. Epub 2004 Dec 6.
37. Kathuria S. Post-Vertebral Augmentation Spine Imaging. Neuroimag Clin N Am 24 (2104) 337-347.
38. Kim Y. J., Lee, J. W., Park, K. W., et al. Pulmonary cement embolism after percutaneous vertebroplasty in osteoporotic vertebral compression fractures: incidence, characteristics, and risk factors. *Radiology*. Apr 2009;251(1):250-259.
39. Klazen CA, Lohle PN, de Vries J, Jansen FH, Tielbeek AV, Blonk MC, et al. Vertebroplasty versus conservative treatment in acute osteoporotic vertebral compression fractures (Vertos II): an open-label randomised trial. *Lancet*. 2010 Sep 25;376(9746):1085-92. Epub 2010 Aug 9.
40. Lavelle W, Carl A, Lavelle ED, Khaleel MA. Vertebroplasty and kyphoplasty. *Med Clin North Am*. 2007 Mar;91(2):299-314.
41. Ledlie JT, Renfro M. Balloon kyphoplasty: one-year outcomes in vertebral body height restoration, chronic pain, and activity levels. *J Neurosurg*. 2003 Jan;98(1 Suppl):36-42.age 17 of 18 Coverage Policy Number: 0040
42. Ledlie JT. Renfro MB. Kyphoplasty treatment of vertebral fractures: 2-year outcomes show sustained benefits. *Spine*. 2006 Jan 1;31(1):57-64.
43. Lee M. J., Dumonski, M., Cahill, P., et al. Percutaneous treatment of vertebral compression fractures: a meta-analysis of complications. *Spine (Phila Pa 1976)*. May 15 2009;34(11):1228-1232.
44. Lovi A., Teli, M., Ortolina, A., et al. Vertebroplasty and kyphoplasty: complementary techniques for the treatment of painful osteoporotic vertebral compression fractures. A prospective non-randomised study on 154 patients. Eur Spine J. Jun 2009;18 Suppl 1:95-101.
45. Mattie, R., Brar, N., Tram, J., McCormick, Z., Beall, D., Fox, A. and Saltychev, M., 2021. Vertebral Augmentation of Cancer-Related Spinal Compression Fractures. *Spine*, 46(24), pp.1729-1737.
46. Mattie R, Laimi K, Yu S, Saltychev M. Comparing Percutaneous Vertebroplasty and Conservative Therapy for Treating Osteoporotic Comperssion Fractures in the Thoracic and Lumbar Spine. *JBJS*. 2016; 98: 1041-51.
47. National Institute for Clinical Excellence (NICE). *Balloon kyphoplasty for vertebral compression fractures*. Interventional procedure guidance 166. London, UK: NICE; 2006 Apr. Revised 2008 Jan.
48. National Institute for Clinical Excellence (NICE). *Percutaneous vertebroplasty*. Interventional procedure guidance 12. London, UK: NICE; 2003 Sept. Revised 2008 Nov.
49. Noriega D, Marcia S, Theumann N et al. A prospective, international, randomized, noninferiority study comparing an implantable titanium vertebral augmentation device versus balloon kyphoplasty in the reduction of vertebral compression fractures (SAKOS study). *Spine J*. 2019;19(11):1782-1795. doi:10.1016/j.spinee.2019.07.009.

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50. Otten LA, Bornemann R, Jansen TR, et al. Comparison of balloon kyphoplasty with the new KIVA® VCF system for the treatment of vertebral compression fractures. *Pain Physician*. 2013; 16:E505-E512.
51. Pateder DB, Khanna AJ, Lieberman IH. Vertebroplasty and kyphoplasty for the management of osteoporotic vertebral compression fractures. *Orthop Clin North Am*. 2007 Jul;38(3):409-18; abstract vii.
52. Rousing R, Andersen MO, Jespersen SM, et al. Percutaneous vertebroplasty compared to conservative treatemtn in patients with painful acute or subacture osteoporotic vertebral fractures. *Spine*. 2009; 34(13): 1349-54.
53. Rousing R, Hansen KL, Andersen MO, et al. Twelve-months follow-up in forty-nine patients with acute/semiacute osteoporotic vertebral fractures treated conservatively or with percutaneous vertebroplasty: a clinical randomized study. *Spine*. 2010; 35(5): 478-482.
54. Savage JW, Schroeder GD, Anderson PA. Review Article: Vertebroplasy and Kyphoplasty for the Treatment of Osteoporotic Vertebral Compression Fractures. *J Am Acad Orthop Surg*. 2014; 22: 653-664.
55. Sorensen ST, Kirkegaard AO, Carreon L, et al. Vertebroplasty or kyphoplasty as palliative treatment for cancer-related vertebral compression fractures: a systematic review. *Spine J*. 2019;19: 1067-75.
56. Spivak JM, Johnson MG. Percutaneous treatment of vertebral body pathology. *J Am Acad Orthop Surg*. 2005 Jan-Feb;13(1):6-17.
57. Staples MP, Kallmes DF, Comstock BA, Jarvik JG, Osborne RH, Heagerty PJ, Buchbinder R. Effectiveness of vertebroplasty using individual patient data from two randomised placebo controlled trials: meta-analysis. *BMJ*. 2011 Jul 12;343:d3952.
58. Taylor R. S., Fritzell, P., Taylor, R. J. Balloon kyphoplasty in the management of vertebral compression fractures: an updated systematic review and meta-analysis. *Eur Spine J*. Aug 2007;16(8):1085-1100.
59. Taylor RS, Fritzell P, Taylor RJ. Balloon kyphoplasty in the management of vertebral compression fractures: an updated systematic review and meta-analysis. *Eur Spine J*. 2007 Feb 3;
60. Taylor RS, Taylor RJ, Fritzell P. Balloon kyphoplasty and vertebroplasty for vertebral compression fractures: a comparative systematic review of efficacy and safety. *Spine*. 2006 Nov 1;31(23):2747-55.
61. Therapeutic Neuroradiology, Society of Interventional Radiology, American Association of Neurological Surgeons/Congress of Neurological Surgeons, and American Society of Spine Radiology. *Vasc Interv Radiol*. 2009 Jul;20(7 Suppl):S326-31.
62. Trout AT, Kallmes DF, Kaufmann TJ. New fractures after vertebroplasty: adjacent fractures occur significantly sooner. *AJNR*. 2006 Jan;27(1):217-23.
63. Tutton SM, Pflugmacher R, Davidian M, et al. KAST Study: the Kiva system as a vertebral augmentation treatment – a safety and effectiveness trial: a randomized, noninferiority trial comparing the Kiva system with balloon kyphoplasty in treatment of osteoporotic vertebral compression fractures. *Spine*. 2015 Jun:40(12):865-75. doi: 10.1097/BRS.0000000000000906.
64. U.S. Department of Health and Human Services. FDA Public Health Notification*: *Complications Related to the Use of Bone Cement and Bone Void Fillers in Treating Compression Fractures of the Spine*. 2002 Oct 31; Updated May 7, 2004.
65. Wardlaw D, Cummings SR, Van Meirhaeghe J, Bastian L, Tillman JB, Ranstam J, et al. Efficacy and safety of balloon kyphoplasty compared with non-surgical care for vertebral compression fracture (FREE): a randomised controlled trial. *Lancet*. 2009 Mar 21;373(9668):1016-24. Epub 2009 Feb 24.
66. Washington State Health Care Authority. *Vertebroplasty, kyphoplasty and Sacroplasty Health Technology Assessment*. Olympia WA: Health Technology Assessment Program, 2010 Nov.
67. Yang E, Xu J, Huang G, Xiao W, Liu X, Zeng B, Lian, X. Percutaneous Vertebroplasty versus Conservative Treatment in Aged Patients With Acute Osteoporotic Vertebral Compression Fractures. *Spine*. 2016 Apr: 41(8) 653-660.

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