Effective Health Care

Symptomatic Osteoporotic Spinal Compression Fractures

Results of Topic Selection Process & Next Steps

The nominator, the American Academy of Orthopaedic Surgeons (AAOS), is interested a new AHRQ review on the diagnosis and treatment of symptomatic osteoporotic spinal compression fractures to inform the update their 2010 clinical practice guideline.

Due to limited program resources, the program will not develop a review at this time. No further activity on this topic will be undertaken by the AHRQ Effective Health Care (EHC) Program.

Topic Brief

Topic Name: Symptomatic Osteoporotic Spinal Compression Fractures

Topic #: 0681

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Conflict of Interest: None of the investigators have any affiliations or financial involvement that conflicts with the material presented in this report.

Summary of Key Findings:

- Appropriateness and importance: This topic is both appropriate and important.
- Duplication: A new AHRQ review would not be duplicative of an existing product.
    - We identified evidence reviews examining the diagnostic accuracy of signs and symptoms for identifying spinal fractures among those with low back pain (KQ1a); the effectiveness of bracing (KQ2a), pharmacological interventions (KQ2b), surgical interventions (ie, kyphoplasty, vertebroplasty; KQ2c), and exercise interventions (KQ2d).
    - We did not identify any evidence reviews on the diagnostic accuracy of X-Ray (KQ1b), CT scan (KQ1c), MRI (KQ1d) or DXA (KQ1e), or any reviews on bed rest, complementary or alternative medicine, nerve blocks, electrical stimulation, or improvement of kyphosis angle (KQ2e).
- Feasibility: A new AHRQ review is feasible.
    - *Size/scope of review:* We identified 17 potentially relevant studies from our random sample of 200 studies, including 8 studies examining the diagnostic accuracy of either X-Ray (KQ1b), CT scan (KQ1c), MRI (KQ1d), or DXA scan

(KQ1e); 1 study on the effectiveness of bracing (KQ2a); and 9 studies on the effectiveness of surgical procedures (KQ2c). We did not identify any studies on the diagnostic accuracy of clinical assessments (KQ1a) or the effectiveness of pharmacological interventions (KQ2b), exercise (KQ2d) or other interventions such as bed rest, complementary or alternative medicine, nerve blocks, electrical stimulation, or improvement of kyphosis angle (KQ2e).
    - *Clinicaltrials.gov:* We identified 2 ongoing trials on ClinicalTrials.gov, both of which examined surgical interventions.
- Impact: A new AHRQ review on this topic has high impact potential due to the lack of current guidance on the accuracy and reliability of diagnostic tools, as well as inconclusive evidence for the majority of treatment options in the AAOS 2010 clinical practice guidelines.
- Value: A new AHRQ review on this topic has high value potential, given that AAOS will use a new AHRQ systematic review to update their 2010 guidelines. This organization has previously produced high-quality evidence-based guidelines, and is transparent about its methodology.

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Introduction

Compression fractures are common among those with osteoporosis, particularly among the elderly. Approximately 25% of all postmenopausal women will have a compression fracture in their lifetime.[1] Spinal compression fractures are the most common type of osteoporotic fractures, affecting 750,000 individuals in the U.S. each year.[2] Symptomatic spinal compression fractures negatively impact patients' quality of life, including pain and functionality. Diagnostic modalities such as a physical examination, X-Ray, CT scan, MRI scan, and DXA bone mineral density scan are often used in conjunction to diagnose spinal fractures and inform treatment decisions. However, there is no good algorithm for determining when certain diagnostic modalities should be utilized, and as a result there are concerns about the under- or over-utilization of diagnostic modalities. In addition, there is no consensus on which patients would benefit the most from surgical interventions such as balloon kyphoplasty and percutaneous vertebroplasty and which patients would benefit from more conservative treatments such as bed rest, bracing, pharmacological treatments, exercise, complementary or alternative medicine, nerve blocks, electrical stimulation, and improvement of kyphosis angle.

Topic nomination *#0681 Symptomatic Osteoporotic Spinal Compression Fractures* was received on June 9, 2016. It was nominated by American Academy of Orthopaedic Surgeons (AAOS). The questions for this nomination are:

Key Question 1. What are the diagnostic accuracy and reliability and/or comparative diagnostic accuracy and reliability of commonly used tools and clinical signs (alone or in combination) for acute and chronic symptomatic osteoporotic spinal compression fractures?

a. Clinical assessments
b. Radiograph (X-ray)
c. Computed tomography (CT)
d. Magnetic resonance imaging (MRI)
e. Bone density assessment (DXA [Dual-energy X-ray Absorptiometry] scan)

Key Question 2. What is the effectiveness and/or comparative effectiveness of interventions to treat symptomatic osteoporotic spinal compression fractures and prevent future symptomatic fractures?

a. " Bracing
b. " Pharmacological treatments (eg, for pain management or treatment for osteoporosis)
c. " Surgical procedures (eg, balloon kyphoplasty, and percutaneous vertebroplasty)
d. " Exercise
e. " Other interventions (eg, bed rest, complementary or alternative medicine, nerve blocks, electrical stimulation, and improvement of kyphosis angle)

To define the inclusion criteria for the key questions we specify the population, interventions, comparators, and outcomes (PICOs) of interest. See Table 1.

Table 1. Key Questions and PICOs "

Key Questions	1. What are the diagnostic accuracy and reliability and/or comparative diagnostic accuracy and reliability of commonly used tools and clinical signs (alone or in combination) for acute and chronic symptomatic osteoporotic spinal compression fractures?	2. What is the effectiveness and/or comparative effectiveness of interventions to treat symptomatic osteoporotic spinal compression fractures and prevent future symptomatic fractures?
Population	Adults (18 years or older)	Adults (18 years or older) with symptomatic osteoporotic spinal compression fractures
Interventions	a. Clinical assessments (eg, physical examination to determine tenderness directly over area of acute fracture, increased kyphosis, tests to assess secondary osteoporosis) b. Radiograph c. Computed tomography (CT) Scan d. Magnetic resonance imaging (MRI) e. Bone density assessment (DXA scan)	a. Bracing b. Pharmacological treatments (eg, alendronate, calcitonin, calcitriol, estrogen, etidronate, fluoride, ibandronate, ipriflavone, menatetrenone, minodronate, pamidronate, phosphate, raloxifene, risedronate, strontium ranelate, teriparatide, opiods, analgesics) c. Surgical procedures (eg, kyphoplasty, vertebroplasty) d. Exercise e. Other (bed rest, complementary or alternative medicine, nerve blocks, electrical stimulation, improvement of kyphosis angle)
Comparators	Any comparator	Any comparator
Outcomes	Accuracy (sensitivity, specificity) and reliability	a. Pain (eg, chronic pain, pain sitting, pain standing, pain walking, pain at rest/night) b. Adult spinal deformity c. Physical functionality (bedridden, functionality scores) d. Quality of life (quality of life scores) e. Analgesic use f. Mortality g. Subsequent fractures

Methods

To assess topic nomination *#0681 Symptomatic Osteoporotic Spinal Compression Fractures* for priority for a systematic review or other AHRQ EHC report, we used a modified process based on established criteria. Our assessment is hierarchical in nature, with the findings of our assessment determining the need for further evaluation. Details related to our assessment are provided in Appendix A.

1. " Determine the *appropriateness* of the nominated topic for inclusion in the EHC program.
2. " Establish the overall *importance* of a potential topic as representing a health or " healthcare issue in the United States. "
3. " Determine the *desirability of new evidence review* by examining whether a new " systematic review or other AHRQ product would be duplicative. "
4. " Assess the *potential impact* a new systematic review or other AHRQ product.
5. " Assess whether the *current state of the evidence* allows for a systematic review or other AHRQ product (feasibility).
6. " Determine the *potential value* of a new systematic review or other AHRQ product.

Appropriateness and Importance

We assessed the nomination for appropriateness and importance (see Appendix A).

Desirability of New Review/Duplication

We searched for high-quality, completed or in-process evidence reviews pertaining to the key questions of the nomination. Table 2 includes the citations for the reviews that were determined to address the key questions. Appendix B includes the list of the sources searched and potentially relevant titles identified by our research librarian.

Impact of a New Evidence Review

The impact of a new evidence review was assessed by analyzing the current standard of care, the existence of potential knowledge gaps, and practice variation. We considered whether a new review could influence the current state of practice through various dissemination pathways (practice recommendation, clinical guidelines, etc.). See Appendix A.

Feasibility of New Evidence Review

We conducted a literature search in PubMed from June 2011 to June 2016.

Because a large number of articles were identified (n=2,899), we reviewed a random sample of 200 titles and abstracts for inclusion and classified identified studies by study design, to assess the size and scope of a potential evidence review. We then calculated the projected total number of included studies based on the proportion of studies included from the random sample. See Table 2, Feasibility Column, Size/Scope of Review Section for the citations of included studies.

We also searched Clinicaltrials.gov for recently completed or in-process unpublished studies. See Appendix B for the PubMed search strategy and links to the ClinicalTrials.gov search.

Value

We assessed the nomination for value (see Appendix A). We considered whether a partner organization could use the information from the proposed evidence review to facilitate evidence-based change; or the presence of clinical, consumer, or policymaking context that is amenable to evidence-based change.

Compilation of Findings
We constructed a table outlining the selection criteria as they pertain to this nomination (see Appendix A).

Results

Appropriateness and Importance
This is an appropriate and important topic. Approximately 25% of all postmenopausal women will have a compression fracture in their lifetime.[1] Spinal compression fractures are the most common type of osteoporotic fractures, affecting 750,000 individuals in the U.S. each year.[2]

Desirability of New Review/Duplication
A new AHRQ review would not be duplicative of an existing product. Although we identified high-quality evidence reviews addressing several of the key questions, none of the reviews fully covered the scope of interventions of interest to the nominator.

We identified 2 evidence reviews examining the diagnostic accuracy of signs and symptoms in identifying spinal fractures among those with low back pain[3,4] (KQ1a), 1 review examining the effectiveness of bracing[5] (KQ2a), 2 reviews examining pharmacological interventions[6,7] (KQ2b),14 reviews examining surgical interventions[8-21] (ie, kyphoplasty, vertebroplasty; KQ2c), and 1 review examining exercise interventions[22] (KQ2d).

We did not identify any completed or in-process evidence reviews on the diagnostic accuracy of X-Ray (KQ1b), CT scan (KQ1c), MRI (KQ1d) or DXA (KQ1e), or any reviews on the effectiveness of other treatments such as bed rest, complementary or alternative medicine, nerve blocks, electrical stimulation, or improvement of kyphosis angle (KQ2e).

See Table 2, Duplication column for the systematic review citations that were determined to address the key questions.

Impact of a New Evidence Review
The new AHRQ review has high impact potential due to the lack of current guidance on the accuracy and reliability of diagnostic tools, as well as inconclusive evidence for the majority of treatment options in the AAOS 2010 clinical practice guidelines. The nominator states that there has been an increase in the volume of literature in the past several years that could potentially address the evidence gaps from the 2010 clinical practice guidelines.

Feasibility of a New Evidence Review
A new evidence review is feasible. We identified 17 relevant studies from our random sample of 200 studies.

These studies included 7 studies examining the accuracy of diagnostic modalities [1 study[23] on X-Ray (KQ1b), 1 study[24] on CT scan (KQ1c), 2 studies[25,26] on MRI (KQ1d), and 4 studies[23,27-29] on DXA (KQ1e)]. We also identified 1 study[30] examining the effectiveness of bracing (KQ2a) and 9 studies[31-39] on the effectiveness of surgical procedures (KQ2c). We did not identify any studies on the diagnostic accuracy of clinical assessments (KQ1a) or the effectiveness of pharmacological interventions (KQ2b), exercise (KQ2d) or other interventions such as bed rest, complementary or alternative medicine, nerve blocks, electrical stimulation, or improvement of kyphosis angle (KQ2e) from our random sample. We also identified 2 ongoing trials[40,41] on ClinicalTrials.gov, both of which examined surgical interventions (KQ2c).
We project there may be 246 total studies examining the key questions.

See Table 2, Feasibility column for the citations that were determined to address the key questions.

Table 2. Key questions with the identified corresponding evidence reviews and original research

Key Question	Duplication (Completed or In-Process Evidence Reviews)	Feasibility (Published and Ongoing Research)
1a: Clinical assessments	Total number of completed or in-process evidence reviews: 2 • Cochrane: 1[3] • Other: 1[4]	Size/scope of review None identified. ClinicalTrials.Gov None identified.
1b: Radiograph (X-Ray)	None identified.	Size/scope of review Relevant Studies: 1 • Prospective cohort: 1[23] Projected Total Studies: 13 ClinicalTrials.Gov None identified.
1c: CT scan	None identified.	Size/scope of review Relevant Studies: 1 • Prospective cohort: 1[24] Projected Total Studies: 13 ClinicalTrials.Gov None identified.
1d: MRI scan	None identified.	Size/scope of review Relevant Studies: 2 • Retrospective case-control: 1[25] • Retrospective cohort: 1[26] Projected Total Studies: 27 ClinicalTrials.Gov None identified.
1e: DXA scan	None identified.	Size/scope of review Relevant Studies: 4 • Prospective cohort: 2[23 27] • Retrospective cohort: 2[28,29] Projected Total Studies: 54 ClinicalTrials.Gov None identified.
2a: Bracing	Total number of completed or in-process evidence reviews • Other: 1[5]	Size/scope of review Relevant Studies Identified: 1 • Prospective cohort: 1[30] Projected Total Studies: 13 ClinicalTrials.Gov None identified.
2b: Pharmacological treatments	Total number of completed or in-process evidence reviews • Other: 1[6,7]	Size/scope of review None identified. ClinicalTrials.Gov None identified.
2c: Surgical procedures Vertebroplasty,	Total number of completed or in-process evidence reviews: 14 • Cochrane: 1[8] • Other: 12[9-20]	Size/scope of review Relevant Studies: 9 • RCTs: 3[31-33] • Prospective non-randomized

Key Question	Duplication (Completed or In-Process Evidence Reviews)	Feasibility (Published and Ongoing Research)
Kyphoplasty, and other surgical procedures	• In-Process (other): 1[21]	comparative: 2 [34,35] • Prospective cohort: 1[36] • Retrospective cohort: 2[37,38] • Retrospective case-series: 1[39] Projected Total Studies: 121 ClinicalTrials.Gov Relevant studies: 2 • Recruiting – 2[40,41]
2d: Exercise	Total number of completed or in-process systematic reviews: 1 • Cochrane: 1[22]	Size/scope of review None identified. Clinical trials None identified.
2e: Other interventions	None identified.	Size/scope of review None identified. Clinical trials None identified.

Abbreviations: CT=Computerized Tomography; DXA= Dual-energy X-ray Absorptiometry; MRI=Magnetic Resonance Imaging; RCT=Randomized Controlled Trial; SOE= Strength of evidence; SOR= Strength of recommendation

Value

A new AHRQ review has high value potential, given that AAOS will use a new AHRQ systematic review to update their 2010 guidelines. This organization has previously produced high-quality evidence-based guidelines, and is transparent about its methodology.

Summary of Findings

- Appropriateness and importance: This topic is both appropriate and important.
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    - *Clinicaltrials.gov:* We identified 2 ongoing trials on ClinicalTrials.gov, both of which examined surgical interventions.

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References

1. " Alexandru D, So W. Evaluation and management of vertebral compression fractures. *The Permanente journal.* Fall 2012;16(4):46-51.
2. " American Association of Neurological Surgeons. Patient Information: Vertebral Compression Fractures. May 2016; http://www.aans.org/patient%20information/conditions%20and%20treatments/vertebral%20compression%20fractures.aspx. Accessed Feb 10, 2017.
3. " Williams CM, Henschke N, Maher CG, et al. Red flags to screen for vertebral fracture in patients presenting with low-back pain. *Cochrane Database of Systematic Reviews.* 2013(1).
4. " Downie A, Williams CM, Henschke N, et al. Red flags to screen for malignancy and fracture in patients with low back pain: systematic review. *BMJ.* 2013;347:f7095.
5. " Goodwin VA, Hall AJ, Rogers E, Bethel A. Orthotics and taping in the management of vertebral fractures in people with osteoporosis: a systematic review. *BMJ Open.* 05/04/2016;6(5):e010657.
6. " Knopp-Sihota JA, Newburn-Cook CV, Homik J, Cummings GG, Voaklander D. Calcitonin for treating acute and chronic pain of recent and remote osteoporotic vertebral compression fractures: a systematic review and meta-analysis. *Osteoporos Int.* Jan 2012;23(1):17-38.
7. " Crandall CJ, Newberry SJ, Diamant A, et al. Comparative effectiveness of pharmacologic treatments to prevent fractures: an updated systematic review. *Ann Intern Med.* Nov 18 2014;161(10):711-723.
8. " Buchbinder R, Golmohammadi K, Johnston RV, et al. Percutaneous vertebroplasty for osteoporotic vertebral compression fracture. *Cochrane Database of Systematic Reviews.* 2015(4).
9. " Anderson PA, Froyshteter AB, Tontz WL. Meta-analysis of vertebral augmentation compared with conservative treatment for osteoporotic spinal fractures. *Journal of Bone and Mineral Research.* 2013;28(2):372-382.
10. " Chang X, Lv YF, Chen B, et al. Vertebroplasty versus kyphoplasty in osteoporotic vertebral compression fracture: a meta-analysis of prospective comparative studies. *Int Orthop.* Mar 2015;39(3):491-500.
11. " 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. *International Orthopaedics.* 06/03/2011;35(9):1349-1358.
12. " Robinson Y, Olerud C. Vertebroplasty and kyphoplasty--a systematic review of cement augmentation techniques for osteoporotic vertebral compression fractures compared to standard medical therapy. *Maturitas.* May 2012;72(1):42-49.
13. " Song D, Meng B, Gan M, et al. The incidence of secondary vertebral fracture of vertebral augmentation techniques versus conservative treatment for painful osteoporotic vertebral fractures: a systematic review and meta-analysis. *Acta Radiol.* Aug 2015;56(8):970-979.

14. " Tian J, Xiang L, Zhou D, Fan Q, Ma B. The clinical efficacy of vertebroplasty on osteoporotic vertebral compression fracture: a meta-analysis. *Int J Surg.* Dec 2014;12(12):1249-1253.
15. " Xiao H, Yang J, Feng X, et al. Comparing complications of vertebroplasty and kyphoplasty for treating osteoporotic vertebral compression fractures: a meta-analysis of the randomized and non-randomized controlled studies. *Eur J Orthop Surg Traumatol.* Jul 2015;25 Suppl 1:S77-85.
16. " Xing D, Ma JX, Ma XL, et al. A meta-analysis of balloon kyphoplasty compared to percutaneous vertebroplasty for treating osteoporotic vertebral compression fractures. *J Clin Neurosci.* Jun 2013;20(6):795-803.
17. " Zhang YZ, Kong LD, Cao JM, Ding WY, Shen Y. Incidence of subsequent vertebral body fractures after vertebroplasty. *J Clin Neurosci.* Aug 2014;21(8):1292-1297.
18. " Huang Z, Wan S, Ning L, Han S. Is unilateral kyphoplasty as effective and safe as bilateral kyphoplasties for osteoporotic vertebral compression fractures? A meta-analysis. *Clin Orthop Relat Res.* Sep 2014;472(9):2833-2842.
19. " Chen H, Tang P, Zhao Y, Gao Y, Wang Y. Unilateral versus bilateral balloon kyphoplasty in the treatment of osteoporotic vertebral compression fractures. *Orthopedics.* Sep 2014;37(9):e828-835.
20. " Lin J, Zhang L, Yang HL. Unilateral versus bilateral balloon kyphoplasty for osteoporotic vertebral compression fractures. *Pain Physician.* Sep-Oct 2013;16(5):447-453.
21. " Kan SL, Yuan, Z.F. Ning, G.Z., Chen, L.X., Sun, J.C., Feng, S.Q. Which is best for osteoporotic vertebral compression fracture, balloon kyphoplasty, percutaneous vertebroplasty or nonsurgical treatment? A Bayesian network meta-analysis. 2016; http://www.crd.york.ac.uk/prospero/display_record.asp?ID=CRD42016039452. Accessed June 15, 2016.
22. " Giangregorio LM, MacIntyre NJ, Thabane L, Skidmore CJ, Papaioannou A. Exercise for improving outcomes after osteoporotic vertebral fracture. *Cochrane Database of Systematic Reviews.* 2013(1).
23. " Diacinti D, Guglielmi G, Pisani D, et al. Vertebral morphometry by dual-energy X-ray absorptiometry (DXA) for osteoporotic vertebral fractures assessment (VFA). *Radiol Med.* Dec 2012;117(8):1374-1385.
24. " Baum T, Muller D, Dobritz M, Rummeny EJ, Link TM, Bauer JS. BMD measurements of the spine derived from sagittal reformations of contrast-enhanced MDCT without dedicated software. *Eur J Radiol.* Nov 2011;80(2):e140-145.
25. " Bandirali M, Di Leo G, Papini GD, et al. A new diagnostic score to detect osteoporosis in patients undergoing lumbar spine MRI. *Eur Radiol.* Oct 2015;25(10):2951-2959.
26. " Ogura A, Hayakawa K, Maeda F, et al. Differential diagnosis of vertebral compression fracture using in-phase/opposed-phase and short TI inversion recovery imaging. *Acta Radiol.* May 1 2012;53(4):450-455.
27. " Aubry-Rozier B, Hans D, Krieg MA, Lamy O, Dudler J. Morphometric vertebral assessments via the use of dual X-ray absorptiometry for the evaluation of radiographic damage in ankylosing spondylitis: a pilot study. *J Clin Densitom.* Jan-Mar 2014;17(1):190-194.
28. " Aubry-Rozier B, Chapurlat R, Duboeuf F, et al. Reproducibility of Vertebral Fracture Assessment Readings From Dual-energy X-ray Absorptiometry in Both a Population-based and Clinical Cohort: Cohen's and Uniform Kappa. *J Clin Densitom.* Apr-Jun 2015;18(2):233-238.
29. " Krueger D, Fidler E, Libber J, Aubry-Rozier B, Hans D, Binkley N. Spine trabecular bone score subsequent to bone mineral density improves fracture discrimination in women. *J Clin Densitom.* Jan-Mar 2014;17(1):60-65.
30. " Valentin GH, Pedersen LN, Maribo T. Wearing an active spinal orthosis improves back extensor strength in women with osteoporotic vertebral fractures. *Prosthet Orthot Int.* Jun 2014;38(3):232-238.

31. " Gu YT, Zhu DH, Liu HF, Zhang F, McGuire R. Minimally invasive pedicle screw fixation combined with percutaneous vertebroplasty for preventing secondary fracture after vertebroplasty. *J Orthop Surg Res.* 2015;10:31.
32. " Chen C, Bian J, Zhang W, Zhang W, Zhao C, Wei H. Unilateral versus bilateral vertebroplasty for severe osteoporotic vertebral compression fractures. *J Spinal Disord Tech.* Dec 2014;27(8):E301-304.
33. " Chen D, An ZQ, Song S, Tang JF, Qin H. Percutaneous vertebroplasty compared with conservative treatment in patients with chronic painful osteoporotic spinal fractures. *J Clin Neurosci.* Mar 2014;21(3):473-477.
34. " Li X, Yang H, Tang T, Qian Z, Chen L, Zhang Z. Comparison of kyphoplasty and vertebroplasty for treatment of painful osteoporotic vertebral compression fractures: twelve-month follow-up in a prospective nonrandomized comparative study. *J Spinal Disord Tech.* May 2012;25(3):142-149.
35. " Figueiredo N, Rotta R, Cavicchioli A, Gonsales D, Casulari LA. Kyphoplasty versus percutaneous vertebroplasty using the traditional and the new side-opening cannula for osteoporotic vertebral fracture. *J Neurosurg Sci.* Dec 2011;55(4):365-370.
36. " Anselmetti GC, Marcia S, Saba L, et al. Percutaneous vertebroplasty: multi-centric results from EVEREST experience in large cohort of patients. *Eur J Radiol.* Dec 2012;81(12):4083-4086.
37. " Yang SC, Chen HS, Kao YH, Tu YK, Liu K, Cheng HC. Clinical evaluation of percutaneous vertebroplasty for symptomatic adjacent vertebral compression fracture. *J Spinal Disord Tech.* Jun 2013;26(4):E130-136.
38. " Xu BS, Hu YC, Yang Q, Xia Q, Ma XL, Ji N. Long-term results and radiographic findings of percutanous vertebroplasties with polymethylmethacrylate for vertebral osteoporotic fractures. *Chin Med J (Engl).* Aug 2012;125(16):2832-2836.
39. " Yu CW, Hsieh MK, Chen LH, et al. Percutaneous balloon kyphoplasty for the treatment of vertebral compression fractures. *BMC Surg.* 2014;14:3.
40. " Centre hospitalier de l'Université de Montréal. Vertebroplasty In The Treatment Of Acute Fracture Trial - The VITTA Trial (VITTA). *Clinicaltrails.gov.* 2016;NCT02370628.
41. " Vexim SA. A Prospective, Multicenter, Randomized, Comparative Clinical Study to Compare the Safety and Effectiveness of Two Vertebral Compression Fracture (VCF) Reduction Techniques: the SpineJack and the KyphX Xpander Inflatable Bone Tamp. *Clinicaltrials.gov.* 2015;NCT02461810.
42. " Buchbinder R, Osborne RH, Ebeling PR, et al. A Randomized Trial of Vertebroplasty for Painful Osteoporotic Vertebral Fractures. *New England Journal of Medicine.* 2009;361(6):557-568.

Appendices

Appendix A: Selection Criteria Summary (

Appendix B: Search Strategy & Results (Feasibility)

Appendix A. Selection Criteria Summary (

Selection Criteria	Supporting Data
1. Appropriateness	
1a. Does the nomination represent a health care drug, intervention, device, technology, or health care system/setting available (or soon to be available) in the U.S.?	Yes, this topic represents health care drugs and interventions available in the U.S.
1b. Is the nomination a request for a systematic review?	Yes, this topic is a request for a systematic review.
1c. Is the focus on effectiveness or comparative effectiveness?	The focus of this review is on both effectiveness and comparative effectiveness.
1d. Is the nomination focus supported by a logic model or biologic plausibility? Is it consistent or coherent with what is known about the topic?	Yes, it is biologically plausible. Yes, it is consistent with what is known about the topic.
2. Importance	
2a. Represents a significant disease burden; large proportion of the population	Yes, this topic represents a significant burden. Approximately 25% of all postmenopausal women will have a compression fracture in their lifetime.[1] Spinal compression fractures are the most common type of osteoporotic fractures, affecting 750,000 individuals in the U.S. each year.[2]
2b. Is of high public interest; affects health care decision making, outcomes, or costs for a large proportion of the US population or for a vulnerable population	Yes, this topic affects heath care decisions for a large, vulnerable population.
2c. Represents important uncertainty for decision makers	Yes, this topic represents important uncertainty for decision makers. There is no good algorithm for determining when certain diagnostic modalities should be utilized, and as a result there are concerns about the under- or over-utilization of diagnostic modalities. In addition, there is no consensus about which patients would benefit from surgical interventions such as balloon kyphoplasty or percutaneous vertebroplasty and which patients would benefit from more conservative interventions.
2d. Incorporates issues around both clinical benefits and potential clinical harms	Yes, this topic addresses both benefits and potential harms of treatments for symptomatic osteoporotic spinal compression fractures.
2e. Represents high costs due to common use, high unit costs, or high associated costs to consumers, to patients, to health care systems, or to payers	Yes, this topic represents high costs to consumers.
3. Desirability of a New Evidence Review/Duplication	
3. Would not be redundant (i.e., the proposed topic is not already covered by available or soon-to-be available high-quality systematic review by AHRQ or others)	A new review would not be duplicative of an existing product. We identified one Cochrane review[3] and one evidence review for KQ1a[4], one evidence review for KQ2a (2016[5]), two evidence reviews for KQ2b (2014[7], 2012[6]), one Cochrane review (2013[17]), twelve evidence reviews (one in 2011[11], one in 2012,[12], three in 2013,[9,16,20]; four in 2014,[14,17-19] three in 2015, [10,13,15])and one in process review (2016[30])

	for KQ2c and one Cochrane review for KQ2d (2013[22]). We identified no completed or in-process evidence reviews for KQ1b-e or KQ2e.
4. Impact of a New Evidence Review	
4a. Is the standard of care unclear (guidelines not available or guidelines inconsistent, indicating an information gap that may be addressed by a new evidence review)?	Yes, the standard of care is unclear due to inconclusive evidence supporting previous guidelines.
4b. Is there practice variation (guideline inconsistent with current practice, indicating a potential implementation gap and not best addressed by a new evidence review)?	Yes, there is practice variation due to inconclusive evidence from previous guidelines.
5. Primary Research	
5. Effectively utilizes existing research and knowledge by considering: - Adequacy (type and volume) of research for conducting a systematic review - Newly available evidence (particularly for updates or new technologies)	A new review is feasible. *Size/scope of the review:* Out of the 200 random articles, we identified 17 studies potentially relevant to the key questions in the nomination. We project there may be 248 relevant studies across all key questions. From our sample, we identified one observational study for KQ1b (2012[23]), one observational study for KQ1c (2011[24]), two observational studies for KQ1d (2012[26] and 2015[25]), four observational studies for KQ1e (2012,[23] 2014,[27 29]and 2015[28]), one observational study for KQ2a (2014[30]) and three RCTs and six observational studies for KQ2c (one in 2011,[35] three in 2012,[34,36,38] one in 2013,[37] four in 2014,[32,33,39] and one in 2015[31]). We did not identify any studies for KQ1a, KQ2b, KQ2d, or KQ2e from our random sample. *Clinicaltrials.gov:* We identified clinical trials[38,39] for KQ2c, but not for any other key sub-questions.
6. Value	
6a. The proposed topic exists within a clinical, consumer, or policy-making context that is amenable to evidence-based change	A 2009 RCT[42] showing no difference between vertebroplasty and a sham procedure on pain ignited discussion and research on the benefits and harms of surgical versus conservative treatments for osteoporotic compression fractures. There is still debate on how to best diagnose and treat symptomatic osteoporotic spinal compression fractures. A review on this topic would impact inform the development of guidelines for AAOS as well as impact clinical decision-making to optimize benefits of treatment while reducing potential harms.
6b. Identified partner who will use the systematic review to influence practice (such as a guideline or recommendation)	Yes, the AAOS will develop evidence-based guidelines based on the results of an AHRQ evidence review.

Abbreviations: AAOS=American Academy of Orthopaedic Surgeons; AHRQ=Agency for Healthcare and Research Quality; KQ=Key Question

Appendix B. Search Strategy & Results (Feasibility)

Topic: Spinal Compression Fractures Date: June 10, 2016 Database Searched: PubMed	
Concept	**Search String**
Spinal Compression Fractures: Diagnosis or Treatments	(((("Osteoporotic Fractures/diagnosis"[Mesh] OR "Osteoporotic Fractures/therapy"[Mesh])) OR ("Fractures, Compression/diagnosis"[Mesh] OR "Fractures, Compression/therapy"[Mesh])) OR ("Spinal Fractures/diagnosis"[Mesh] OR "Spinal Fractures/therapy"[Mesh]))
Not Editorials, etc.	((((("Letter"[Publication Type]) OR "News"[Publication Type]) OR "Patient Education Handout"[Publication Type]) OR "Comment"[Publication Type]) OR "Editorial"[Publication Type])) OR "Newspaper Article"[Publication Type]
Limit to last 5 years Human English	Filters activated: published in the last 5 years, Humans, English
N=2899	
Systematic Review **N=210**	PubMed subsection “Systematic [sb]”
Randomized Controlled Trials **N=890**	Cochrane Sensitive Search Strategy for RCT’s “(((((((groups[tiab])) OR (trial[tiab])) OR (randomly[tiab])) OR (drug therapy[sh])) OR (placebo[tiab])) OR (randomized[tiab])) OR (controlled clinical trial[pt])) OR (randomized controlled trial[pt])”
Other **N=1799**	

ClinicalTrials.gov searched on June 10, 2016
20 studies found for: (spinal OR vertebral) compression fracture | received on or after 06/10/2011
Link to Results:
https://clinicaltrials.gov/ct2/results?term=&recr=&rslt=&type=&cond=%28spinal+OR+vertebral%29+compression+fracture&intr=&titles=&outc=&spons=&lead=&id=&state1=&cntry1=&state2=&cntry2=&state3=&cntry3=&locn=&gndr=&rcv_s=06%2F10%2F2011&rcv_e=&lup_s=&lup_e=