Guideline summary review: An evidence-based clinical guideline for the diagnosis and treatment of adults with osteoporotic vertebral compression fractures

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ABSTRACT

Background Context:

The North American Spine Society's (NASS) Evidence-Based Clinical Guideline for the Diagnosis and Treatment of Adults with Osteoporotic Vertebral Compression Fractures features evidence-based recommendations for diagnosing and treating adult patients with osteoporotic vertebral compression fractures. The guideline is intended to reflect contemporary treatment concepts for osteoporotic vertebral compression fractures as reflected in the highest quality clinical literature available on this subject as of September 2020.

Purpose:

The purpose of the guideline is to provide an evidence-based educational tool to assist spine specialists when making clinical decisions for adult patients with osteoporotic vertebral compression fractures. This article provides a brief summary of the evidence-based guideline recommendations for diagnosing and treating patients with this condition.

Study Design:

This is a guideline summary review**.**

Methods:

This guideline is the product of NASS' Clinical Practice Guidelines Committee. The methods used to develop this guideline are detailed in the complete guideline and technical report available on the NASS website. In brief, a multidisciplinary work group of spine care specialists convened to identify clinical questions to address in the guideline. The literature search strategy

was developed in consultation with a medical librarian. Upon completion of the systematic literature search, evidence relevant to the clinical questions posed in the guideline was reviewed. Work group members utilized NASS evidentiary table templates to summarize study conclusions, identify study strengths and weaknesses, and assign levels of evidence. Work group members participated in recommendation meetings to update and formulate evidence-based recommendations and incorporate expert opinion when necessary. The draft guideline was submitted to an internal and external peer review process and ultimately approved by the NASS Board of Directors.

Results:

Twenty-nine clinical questions were addressed, and the answers are summarized in this article. The respective recommendations were graded according to the levels of evidence of the supporting literature.

Conclusions:

The evidence-based clinical guideline has been created using techniques of evidence-based medicine and best available evidence to aid practitioners in the diagnosis and treatment of adult patients with osteoporotic vertebral compression fractures. The entire guideline document, including the evidentiary tables, literature search parameters, literature attrition flowchart, suggestions for future research, and all of the references, is available electronically on the NASS website at http://www.spine.org/guidelines.

Key Words

Osteoporotic; vertebral fracture; diagnosis; treatment; evidence-based guideline

MANUSCRIPT

Introduction

To improve the knowledge base concerning the diagnosis and treatment of adults with osteoporotic vertebral compression fractures, the North American Spine Society's (NASS) Clinical Practice Guidelines Committee developed an evidence-based clinical guideline on this topic. When employing the principles of evidence-based medicine, the clinical literature is extensively searched to answer specific clinical questions about a disease state or medical condition. The literature, identified in the search as of September 2020, is rated according to its scientific merit using NASS evidence analysis criteria and the levels of evidence as determined by specific rule sets that apply to human, clinical investigations. The evidence with the highest possible levels of evidence obtained from the searches is utilized to answer the specific clinical questions. As a final step, the answers to clinical questions are reformulated as recommendations. Recommendations are then assigned a recommendation grade according to the level of evidence for the best clinical evidence available at the time of answering each question. The intent of the grade of recommendation is to indicate the strength of evidence used by the work group in answering the question asked.

Methods

The methods used to develop this guideline and guideline development disclosure policies are detailed in the complete guideline [NASS Diagnosis and Treatment of Adults with Osteoporotic Vertebral Compression Fractures] and technical report. [NASS Technical Report] In brief (Figure 1), a multidisciplinary work group of spine care specialists, including representatives from the fields of neurosurgery, orthopedic surgery, physical medicine and rehabilitation, chiropractic care, physical therapy, anesthesiology, research, radiology, and nursing convened to identify clinical questions to address in the guideline. The patient population for this guideline encompasses adults (18 years or older) with osteoporotic vertebral compression fractures defined

as compression fractures of the vertebral body due to decreased cortical or trabecular bone density secondary to osteoporosis. Fractures may or may not be symptomatic and may or may not result in clinically significant deformity and/or neurologic deficit. This includes spine or sacral fractures, single or multiple level fractures, simple or complex fractures, and fractures with or without pain that may be axial, radicular, generalized or a combination. The following conditions were excluded: cervical spine, acute or chronic spine infection including epidural abscess, discitis, and/or osteomyelitis, major trauma, prior surgery at the affected level, isolated intradural tumor, and primary or metastatic tumor involvement to the spine. A full list of inclusion and exclusion criteria can be found in the complete guideline [NASS Diagnosis and Treatment of Adults with Osteoporotic Vertebral Compression Fractures] and technical report. [NASS Technical Report] The literature search strategy was developed in consultation with a medical librarian. Upon completion of the systematic literature search, evidence relevant to the clinical questions posed in the guideline was reviewed. Work group members utilized NASS evidentiary table templates to summarize study conclusions, identify study strengths and weaknesses, and assign levels of evidence according to the NASS Levels of Evidence for Primary Research Question scale, which is outlined in the complete guideline. [NASS Diagnosis and Treatment of Adults with Osteoporotic Vertebral Compression Fractures] Work group members participated in recommendation meetings in person and/or virtually to update and formulate evidence-based recommendations and incorporate expert opinion when necessary. The draft guideline was submitted to an internal peer review process as well as an external review by members of NASS' Clinical Practice Guidelines Committee who were not involved in this guideline, followed by a public comment period. It was ultimately approved by the NASS Board

of Directors. A full list of all authors can be found in the complete clinical guideline. [NASS Diagnosis and Treatment of Adults with Osteoporotic Vertebral Compression Fractures]

Results

Twenty-nine clinical questions were addressed in this guideline. Work group members engaged in a two-step screening process to determine article eligibility, including title and abstract screening and evidentiary review with at least two independent reviewers. The total number of articles retrieved, eligible for critical appraisal, and meeting inclusion criteria for each individual clinical question can be accessed in the technical report. [NASS Technical Report] A total of 70 recommendations were issued.

Summary of Recommendations

Recommendations were graded according to the NASS Grades of Recommendation, which is outlined in the complete guideline. [NASS Diagnosis and Treatment of Adults with Osteoporotic Vertebral Compression Fractures]. In summary, these are Recommendation Grade A=Good evidence, Recommendation Grade B=Fair evidence, Recommendation Grade C=Poor quality evidence, and I=Insufficient or conflicting evidence. The recommendations are summarized below.

Natural History

Natural History Question 1: For patients with osteoporotic vertebral compression fractures managed without augmentation or surgery, what is the risk of development of long-term sequelae of vertebral compression fractures (eg, spinal deformity, respiratory compromise, gastrointestinal tract dysfunction, physical and psychological functional impairment)?

In adults with osteoporotic vertebral compression fractures treated without augmentation or surgery, there is fair evidence to suggest that decline occurs in functional status and activities of daily living. [Matsumoto 2012, Hoshino 2019, Hoshino 2013, Klezl 2012]

Grade of Recommendation: B

In adults with osteoporotic vertebral compression fractures treated without augmentation or surgery, there is poor quality evidence that there may be progressive kyphosis and loss of vertebral body height. [Park 2014, Colangelo 2015]

Grade of Recommendation: C

In adults with osteoporotic vertebral compression fractures treated without augmentation or surgery, there is poor quality evidence that there may be significant medical morbidity associated with the fracture. [Du 2018, Edidin 2015, McCullough 2013]

Grade of Recommendation: C

In adults with osteoporotic vertebral compression fractures treated without augmentation or surgery, there is poor quality evidence that patients are at risk of additional fractures. [Kato 2019, Levy 2012, Lin 2017]

Grade of Recommendation: C

Natural History Question 2: For patients with acute osteoporotic vertebral compression fractures managed without augmentation or surgery, what is the expected time to resolution of pain?

In adults with osteoporotic vertebral compression fractures treated without augmentation or surgery, there is fair evidence to suggest that significant pain improvement will occur. Time course to improvement is variable from three months to one year. In some studies, the time may be overstated due to the interval of follow-up and the time to improvement may vary due to

different medical therapies. [Andrei 2017, Diamond 2003, Du 2018, Kato 2019, Klazen (Vertebroplasty) 2010, Klazen (Clinical) 2010, Li Y 2017, Piazzolla 2015, Venmans 2012, Blasco 2010, Boonen 2011, Diamond 2006, Hoshino 2019, Hoshino 2013, Iwata 2020, Kim YC 2016, Ma 2020, Meccariello 2017, Movrin 2012, Wardlaw 2009, Van Meirhaeghe 2013]

Grade of Recommendation: B

Natural History Question 3: For patients with acute osteoporotic vertebral compression fractures managed without augmentation or surgery, what is the risk of persistent long-term (>6 months) pain?

In adults with osteoporotic vertebral compression fractures treated without augmentation or surgery, there is fair evidence to suggest that a significant percentage of patients will have persistent long-term (greater than 6 months) pain (VAS >3). Most studies suggest approximately a third of patients (ranging from 10-40%). [Du 2018, Hoshino 2013, Klazen (Vertebroplasty) 2010, Klazen (Clinical) 2010, Meccariello 2017, Venmans 2012, Boonen 2011, Iwata 2020, Yasuda 2017]

Grade of Recommendation: B

Natural History Question 4: For patients with osteoporotic vertebral compression fractures, are rates of morbidity and mortality different for those managed with augmentation or surgery versus those managed without?

There is fair evidence to suggest that the new fracture rates are not different in adults with osteoporotic vertebral compression fractures treated with augmentation or surgery as compared to medical treatment. [Du 2018, Boonen 2011, Kim YC 2016]

Grade of Recommendation: B

There is conflicting evidence that precludes making a recommendation on rates of morbidity and mortality for adults with osteoporotic vertebral compression fractures managed with augmentation or surgery compared to those managed without. [Becker 2011, Blasco 2010, Boonen 2011, Chen 2013, Diamond 2006, Gerling 2011, Kim YC 2016, Klezl 2012, Lange 2014, Lavelle 2008, Ong 2018, McCullough 2013, Lin 2017, Edidin 2015, Levy 2012, Zampini 2010]

Grade of Recommendation: I

There is conflicting evidence that precludes making a recommendation for or against the impact of augmentation or surgery versus medical treatment on rate of medical complications in adults with osteoporotic vertebral compression fractures. [Du 2018, Chen 2013, Kim YC 2016]

Grade of Recommendation: I

Natural History Question 5: For patients with osteoporotic vertebral compression fractures managed without augmentation or surgery, are there specific variables that increase the risk for refracture of the same or other vertebral levels?

There is insufficient evidence to make a recommendation for or against the impact of diabetes, smoking, NSAIDS, low FIM score, presentation of multiple fractures, or low segmental cobb angle on risk for refracture of the same or other vertebral level in adults with osteoporotic vertebral compression fractures. [Diamond 2006, Faloon 2015, Yamauchi 2020, Lindsay 2001]

Grade of Recommendation: I

<u>Cost Effectiveness</u>

Cost Effectiveness Question 1: In the treatment of osteoporotic vertebral compression fractures, what is the comparative cost-effectiveness of (a) medical therapy alone vs (b) vertebral

augmentation vs (c) thermal ablation, radiofrequency ablation or cryoablation with or without augmentation vs (d) operative fusion/fixation?

There is insufficient evidence to make a recommendation for or against the cost effectiveness of medical treatment alone vs vertebral augmentation vs thermal ablation, radiofrequency ablation or cryoablation with or without augmentation vs operative fusion/fixation. [Fritzell 2011, Svedbom 2013, Takahashi 2019]

Grade of Recommendation: I

Clinical Diagnosis

Clinical Diagnosis Question 1: Which elements (individual or in combination) of a history, symptoms, and/or physical examination are most sensitive and specific for identifying a patient with an acute osteoporotic vertebral compression fracture?

Presence of positive closed-fist percussion sign, supine sign, or back pain inducing test are suggested as findings on physical exam useful in identifying an adult patient with symptomatic acute osteoporotic vertebral compression fractures. [Jin 2020, Langdon 2010]

Grade of Recommendation: B

There is insufficient evidence to make a recommendation for or against a patient self-assessment screening tool to identify individuals at risk for acute osteoporotic vertebral compression fractures. [Yang 2013]

Grade of Recommendation: I

Medical Treatment

Medical Treatment Question 1: How do nonpharmacologic treatments (eg, bracing, physical therapy, acupuncture, massage, cannabis, exercise, etc.) compare in terms of reducing severity and duration of pain and disability in osteoporotic vertebral compression fractures?

Bracing may be considered for adults for osteoporotic vertebral compression fractures. There is insufficient evidence to recommend a specific type of brace. [Kato 2019, Meccariello 2017, Li M 2015]

Grade of Recommendation: C

There is insufficient evidence to make a recommendation for or against strict immobilization in adults with acute osteoporotic vertebral compression fractures. [Weerink 2014]

Grade of Recommendation: I

There is insufficient evidence to make a recommendation for or against taping in the management of acute osteoporotic vertebral compression fractures. [Palmer 2018]

Grade of Recommendation: I

Medical Treatment Question 2: Do restrictions on patient activity alter outcomes in patients with acute osteoporotic vertebral compression fractures?

There is insufficient evidence to make a recommendation for or against immobilization or early activity in adults with acute osteoporotic vertebral compression fracture. [Weerink 2014]

Grade of Recommendation: I

Medical Treatment Question 3: Which pharmacologic treatments are effective in improving outcomes in acute osteoporotic vertebral compression fractures?

Calcitonin is suggested for relief of pain in adults with acute osteoporotic vertebral compression fractures. [Combe 1997, Laroche 2006, Lyritis 1999, Lyritis 1997, Lyritis 1991, Pun 1989, Tanaka (Effectiveness of monotherapy) 2017, Tanaka (Effectiveness of elcatonin) 2017]

Grade of Recommendation: B

Teriparatide is suggested for the relief of pain and improvement in quality of life in adults with acute osteoporotic vertebral compression fractures. *[Ikeda 2020, Shigenobu 2019, Zhao Y 2016, Tu 2012]*

Grade of Recommendation: B

Bisphosphonates are suggested for relief of pain and improvement in quality of life in adults with acute osteoporotic vertebral compression fracture but are inferior to teriparatide. [Ikeda 2020, Shigenobu 2019, Armingeat 2006, Ma 2020, Min 2019, Rovetta 2001, Rovetta 2000, Zheng 2019]

Grade of Recommendation: B

There is insufficient evidence to make a recommendation for or against denosumab for relief of pain in adults with acute osteoporotic vertebral compression fractures. [Tetsunaga 2017]

Grade of Recommendation: I

There is insufficient evidence to make a recommendation for or against fentanyl for relief of pain in adults with acute osteoporotic vertebral compression fractures. [Choi 2017]

Grade of Recommendation: I

Medical Treatment Question 4: Does spinal manipulative treatment improve outcomes for patients with acute osteoporotic vertebral compression fractures?

A systematic review of the literature yielded no studies to adequately address this question.

Medical Treatment Question 5: In patients presenting with symptomatic acute osteoporotic vertebral compression fractures, does medical treatment of the underlying bone loss improve long-term outcomes such as reduction in risk of future fragility fractures?

Teriparatide may be considered in adults with acute osteoporotic vertebral compression fractures to reduce the risk of future fragility fractures. [Zhao Y 2016, Tu 2012]

Grade of Recommendation: C

Bisphosphonates may be considered in adults with acute osteoporotic vertebral compression fractures to reduce the risk of future fragility fractures. [Zheng 2019, Craig 2011]

Grade of Recommendation: C

Medical Treatment Question 6: Does the involvement of multiple specialties in clinical management change the outcomes of acute osteoporotic vertebral compression fractures?

A systematic review of the literature yielded no studies to adequately address this question.

Imaging Diagnosis

Imaging Question 1: Which imaging modalities and findings are most sensitive and specific for the accurate diagnosis of symptomatic osteoporotic vertebral compression fractures?

Flexion/extension radiographs are suggested as an option for diagnosing acute osteoporotic vertebral compression fractures when MRI cannot be obtained. [Chen YJ 2011, Niimi 2014]

Grade of Recommendation: B

Scintigraphy (bone scan) is suggested as an alternative imaging modality to diagnose acute osteoporotic vertebral compression fractures when MRI cannot be obtained. [Karam 2008, Zhao QM 2016, Li YB 2018]

Grade of Recommendation: B

There is insufficient evidence to make a recommendation for or against dual-energy CT for the diagnosis of acute osteoporotic vertebral compression fractures. [Kaup 2016]

Grade of Recommendation: I

There is insufficient evidence to make a recommendation for or against the use of radiographs for diagnosing acute osteoporotic vertebral compression fractures. [Marongiu 2018]

Grade of Recommendation: I

Imaging Question 2: Which imaging findings stratify the acuity of osteoporotic vertebral compression fractures?

It is suggested that the presence of a fluid sign or edema in dual energy CT scan can differentiate new or acute osteoporotic vertebral compression fractures from older fractures. [Kaup 2016, Schwaiger 2018]

Grade of Recommendation: B

There is insufficient evidence to make recommendation for or against the use of the vacuum sign cleft on radiographs or bone scan to confirm a nonunion painful fracture. [Lin 2015]

Grade of Recommendation: I

Interventional Treatment

Interventional Treatment Question 1: Do steroid and/or anesthetic injections improve outcomes in patients with acute osteoporotic vertebral compression fractures?

There is insufficient evidence to make a recommendation for or against facet blocks in addition to percutaneous vertebroplasty compared to percutaneous vertebroplasty alone in adults with osteoporotic vertebral compression fractures. [Cheng 2020]

Grade of Recommendation: I

There is insufficient evidence to make a recommendation for or against facet blocks with local anesthetics and corticosteroids in adults with osteoporotic vertebral compression fractures. [Wang 2016]

Grade of Recommendation: I

Interventional Treatment Question 2: What is the risk of treating multiple vertebral levels at one time, for patients with multilevel osteoporotic vertebral compression fractures?

Vertebral augmentation may be considered as a safe and effective option to treat multiple vertebral fractures during one procedure time with a low risk in adults with osteoporotic vertebral compression fractures. [Chen L 2011, Ren 2015, Zhai 2015, Zidan 2018]

Grade of Recommendation: C

Interventional Treatment Question 3: Does vertebral augmentation improve outcomes in patients with acute osteoporotic vertebral compression fractures compared to medical therapy?

Vertebral augmentation is recommended as it provides rapid and sustained clinically and statistically significant improvement in pain and function in adults with acute osteoporotic vertebral compression fractures. [Farrokhi 2011, Klazen (Vertebroplasty) 2010, Yang EZ 2016,

Blasco 2012, Bornemann 2012, Diamond 2006, Jin 2018, Leali 2016, Li Y 2017, Movrin 2012, Rousing 2010, Wardlaw 2009, Van Meirhaeghe 2013, Balkarli 2016, Colangelo 2015, Diamond 2003, Faloon 2015, Lee 2012, Ma 2020, Macías-Hernández 2015, Martikos 2018, Masala 2008, Nakano 2006, Oh 2019, Tang 2011, Wang 2010]

Grade of Recommendation: A

Vertebral augmentation is suggested to improve the segmental alignment compared to medical treatment in adults with osteoporotic vertebral compression fractures. [Colangelo 2015, Nakano 2006, Oh 2019, Tang 2011]

Grade of Recommendation: B

There is conflicting evidence to make a recommendation for or against vertebral augmentation compared to medical treatment in terms of new, adjacent-level, or distant fractures in adults with osteoporotic vertebral compression fractures. [Movrin 2012, Yi 2014, Faloon 2015, Martikos 2018]

Grade of Recommendation: I

Interventional Treatment Question 4: Does mechanical device (an implant that includes more than a bone filler) improve outcomes in patients with symptomatic osteoporotic vertebral compression fractures compared to medical care?

A systematic review of the literature yielded no studies to adequately address this question.

Interventional Treatment Question 5: Does the correction of vertebral height loss or segmental kyphosis during vertebral augmentation for symptomatic osteoporotic vertebral compression fractures result in improved clinical outcomes?

For adults with osteoporotic vertebral compression fractures containing vertebral cleft, it is suggested that vertebral augmentation can improve height and wedge angle, but this restoration has no significant difference in pain relief. [Chen 2014, Sun 2011]

Grade of Recommendation: B

It is suggested that kyphoplasty shows improved height restoration and kyphotic angle, but degree of height restoration and kyphotic angle did not provide further improvement in pain relief or function in adults with osteoporotic vertebral compression fractures. [Chi 2020, Palmowski 2020, Park 2010, Zhou 2019, Arabmotlagh 2019, Zapałowicz 2015]

Grade of Recommendation: B

It is suggested that vertebroplasty and kyphoplasty, regardless of height restoration or kyphotic angle improvement, are equivalent in providing pain relief and improved function in adults with osteoporotic vertebral compression fractures. [Du 2014, Liu 2010, Bozkurt 2014, Cheng 2019, Gan 2014, Hu 2018, Kim 2012, Lin 2016, Röllinghoff 2009, Schofer 2009]

Grade of Recommendation: B

Interventional Treatment Question 6: For patients with symptomatic acute osteoporotic vertebral compression fractures, what is the optimal timing for vertebral augmentation?

In adults with osteoporotic vertebral compression fractures, it is suggested that there is optimal timing for treatment with vertebral augmentation and delayed treatment is associated

with worse clinical outcomes. [Diamond 2020, Erkan 2009, Takahashi 2018, Minamide 2018, Son 2014, Yang 2018]

Grade of Recommendation: B

Interventional Treatment Question 7: Does vertebral augmentation improve clinical outcomes in patients with back pain and an intravertebral cleft on imaging of chronic osteoporotic vertebral compression fractures?

There is insufficient evidence to make a recommendation for or against the use of vertebral augmentation to improve back pain in adults with osteoporotic vertebral compression fractures with or without intravertebral clefts in nonacute osteoporotic vertebral compression fractures. [Ha 2006]

Grade of Recommendation: I

Interventional Treatment Question 8: Are there specific characteristics of the fracture or the patient that influence outcomes in patients with osteoporotic compression fractures undergoing vertebral augmentation?

Please note: In the answer to this question, the studies are quite diverse. The work group has chosen to make the following assumptions:

1) BMC, T-Score, and imaging assessments of bone density indicate the same general concept

2) A low T-Score is synonymous with low BMD

3) Cement leakage is an outcome, but does not appear to address the outcomes implied by the question

Patient Factors

It is suggested that decreased bone mineral density is associated with an increased risk of further fractures (new or recollapse) after vertebral augmentation of osteoporotic vertebral compression fractures. [Liu 2012, Movrin 2010, Nieuwenhuijse 2013, Bae 2017, Chen 2019, Gao 2018, Hey 2015, Hiwatashi 2009, Hu 2019, Huang 2018, Komemushi 2008, Lee HJ 2019, Li YX 2018, Lin H 2010, Lu 2012, Sun 2014, Takahara 2016, Tseng 2009, Wang 2014, Wu 2017, Yang S 2016, Lin 2019, Li H 2017, Lee BG 2019, Rho 2012, Alhashash 2019]

Grade of Recommendation: B

It is suggested that increasing age and female sex are associated with increased risk of further fractures (new or recollapse) after vertebral augmentation of osteoporotic vertebral compression fractures. [Zhang 2021, Bayram 2020, Chen 2019, Hey 2015, Takahara 2016, Tseng 2009, Wang 2014, Lee 2006, Civelek 2014, Hu 2019, Moon 2007]

Grade of Recommendation: B

It is suggested that multiple preexisting vertebral fractures are associated with increased risk of further fractures after vertebral augmentation of osteoporotic vertebral compression fractures.[Alhashash 2019, Liu 2012, Voormolen 2006, Lee 2015, Ren 2015, Tseng 2009, Li H 2017]

Grade of Recommendation: B

It is suggested that lower serum 25(OH)D levels are associated with increased risk of further fractures after vertebral augmentation of osteoporotic vertebral compression fractures. [Martinez-Ferrer 2013, Zafeiris 2012]

Grade of Recommendation: B

It is suggested that lower BMI is associated with increased risk of further fractures after vertebral augmentation of osteoporotic vertebral compression fractures. [Zhang 2021, Lee 2015, Lin 2008, Moon 2007, Lin H 2010, Ren 2015]

Grade of Recommendation: B

Comorbidities may be considered as a factor in increased risk of further fractures after vertebral augmentation of osteoporotic vertebral compression fractures. [Deen 2006, Chen 2020, Spross 2014]

Grade of Recommendation: C

There is insufficient evidence to make a recommendation for or against the use of various biomedical markers as risk factors for further fractures after vertebral augmentation of osteoporotic vertebral compression fractures. [Komemushi 2008]

Grade of Recommendation: I

There is insufficient evidence to make a recommendation for or against the effect of long-term steroid use on the outcome of vertebral augmentation for osteoporotic vertebral compression fractures. [Hiwatashi 2007, Hiwatashi 2009, Koch 2007]

Grade of Recommendation: I

There is insufficient evidence to make a recommendation for or against the impact of high preop sacral inclination and high spinal deformity index in evaluating risk of further fractures after vertebral augmentation of osteoporotic vertebral compression fractures. [Nieuwenhuijse 2013, Lee HJ 2019]

Grade of Recommendation: I

There is insufficient evidence to make a recommendation for or against the impact of activity level in evaluating risk of further fractures after vertebral augmentation of osteoporotic vertebral compression fractures.[Liu 2012, Chen 2019]

Grade of Recommendation: I

There is insufficient evidence to make a recommendation for or against the impact of ASA score in predicting VAS scores after vertebral augmentation of osteoporotic vertebral compression fractures.[Alvarez 2005]

Grade of Recommendation: I

There is insufficient evidence to make a recommendation for or against the impact of ASA score in predicting risk of mortality after vertebral augmentation of osteoporotic vertebral compression fractures.[Bayram 2020]

Grade of Recommendation: I

Fracture Factors

It is suggested that intravertebral cleft (IVC) is associated with poor outcomes after vertebral augmentation of osteoporotic vertebral compression fractures. [Denoix 2018, Gao 2018, Ha 2006, Kim 2010, Nakamae 2018, Trout 2006, Wang 2014, Li Y 2020]

Grade of Recommendation: B

It is suggested that higher preoperative kyphotic angle is associated with inferior/poor outcomes, such as new vertebral compression fractures and VAS/RMDQ scores, after vertebral augmentation of osteoporotic vertebral compression fractures. [Borensztein 2018, Civelek 2014, Kang 2011, Khurjekar 2011, Spross 2014]

Grade of Recommendation: B

It is suggested that vertebral compression fractures located in the thoracolumbar junction are associated with a higher risk of new vertebral compression fractures, and also have progressive kyphosis and neurological complications after vertebral augmentation of osteoporotic vertebral compression fractures.[Nieuwenhuijse 2013, Chou 2014, Lee 2011, Sun 2014]

Grade of Recommendation: B

It is suggested that a greater degree of vertebral body edema on preoperative MRI is associated with better outcomes in patients treated with vertebral augmentation for osteoporotic vertebral compression fractures. [Grafe 2011, Lin WC 2010, Xu 2018]

Grade of Recommendation: B

There is insufficient evidence to make a recommendation for or against type of fracture or shape as a risk factor for progressive kyphosis and secondary AVF in patients with osteoporotic vertebral compression fractures underdoing vertebral augmentation. [Chou 2014, De Kong 2013, Wu 2017]

Grade of Recommendation: I

There is insufficient evidence to make a recommendation for or against the presence of osteonecrosis being predisposing factors for recollapse in adults undergoing vertebroplasty for osteoporotic vertebral compression fractures. [Heo 2009]

Grade of Recommendation: I

There is insufficient evidence for or against the occurrence of intradiscal cement leakage in the presence of high signal T2 intensity in the adjacent disc in the absence of endplate cortical disruption. [Hong 2014]

Grade of Recommendation: I

There is insufficient evidence for or against IVC and posterior fascia edema being associated with residual back pain after vertebral augmentation in adults with osteoporotic vertebral compression fractures. [Li Y 2020]

Grade of Recommendation: I

There is insufficient evidence for or against adjacent segment alignment and thoracolumbar alignment being associated with adjacent level fractures after vertebral augmentation in adults with osteoporotic vertebral compression fractures. [Liang 2020]

Grade of Recommendation: I

Surgical Treatment

Surgical Question 1: Does instrumented fusion improve outcomes in patients with acute osteoporotic vertebral compression fractures compared to nonoperative care or interventional procedures?

In adults with osteoporotic vertebral compression fractures with burst morphology, both vertebral augmentation and instrumented fusion may be considered as treatment options as they appear to provide similar clinical outcomes. [An 2008, Kim HS 2016]

Grade of Recommendation: C

There is conflicting evidence to make a recommendation for or against instrumented fusion in adults with acute osteoporotic vertebral compression fractures compared to interventional procedures with respect to radiological outcomes. [An 2008, Kim HS 2016]

Grade of Recommendation: I

Surgical Question 2: What are the clinical or radiological indications for recommending open surgical procedures in patients with acute osteoporotic vertebral compression fractures?

A systematic review of the literature yielded no studies to adequately address this question.

Surgical Question 3: Does the use of minimally invasive surgical approaches (eg, percutaneous pedicle screws, muscle-sparing decompression/arthrodesis techniques) improve outcomes compared to open surgical approaches in patients undergoing surgery for acute osteoporotic vertebral compression fractures?

There is insufficient evidence to make a recommendation for or against minimally invasive surgical approaches compared to open surgical approaches in adults undergoing surgery for acute osteoporotic vertebral compression fractures. [Liu 2020]

Grade of Recommendation: I

Surgical Question 4: What are the risk factors for adjacent vertebral body fractures after surgical intervention in patients with osteoporotic vertebral compression fractures?

There is insufficient evidence to identify risk factors for adjacent vertebral body fractures after surgical intervention in adults with osteoporotic vertebral compression fractures. [Tamai 2018]

Grade of Recommendation: I

Surgical Question 5: Are there specific characteristics of the fracture or the patient that influence outcomes in patients with osteoporotic vertebral compression fractures undergoing surgical treatment?

Spine care providers may consider preoperative hypoalbuminemia as associated with an increased risk of postoperative mortality in adults undergoing surgical treatment for osteoporotic vertebral compression fractures. [Gupta 2019, Ohba 2020]*

Grade of Recommendation: C

** Work Group Narrative: The work group emphasizes that hypoalbuminemia, as it relates to the recommendation above, can be interpreted as a sign of physiologic stress, potentially resulting from disease or trauma-related inflammation, rather than solely a reflection of nutrition status. The work group cautions providers to assess the underlying cause of hypoalbuminemia while applying this recommendation.*

There is insufficient evidence to make a recommendation regarding other patient or fracture characteristics affecting outcomes after surgical intervention for osteoporotic vertebral compression fractures.[Isogai 2020, Maruo 2019, Murata 2020, Tamai 2018]

Grade of Recommendation: I

Surgical Question 6: In patients undergoing surgery for symptomatic osteoporotic vertebral compression fractures, are clinical and radiological outcomes affected by the types of implants used?

PMMA screw augmentation may be considered as an option to reduce the risk of postoperative screw loosening in adults undergoing surgery for osteoporotic vertebral compression fractures. [Girardo 2018, El Saman 2013]

Grade of Recommendation: C

There is insufficient evidence to make a recommendation for or against the use of anterior vs posterior vs anterior plus posterior techniques in adults with neurological deficits

undergoing surgery for osteoporotic vertebral compression fractures. [Kashii 2013, Nakashima 2015, Sudo 2013, Uchida 2010]

Grade of Recommendation: I

Discussion

This evidence-based clinical guideline for the diagnosis and treatment of adults with osteoporotic vertebral compression fractures has several functions. It is an educational tool for both clinicians and patients, and as such this particular guideline is intended to assist practitioners who treat adult patients with osteoporotic vertebral compression fractures. This guideline also serves to focus and rate the scientific data on this topic. An evidence-based guideline such as this allows a clinician access to the best and most current evidence and reduces the burden of "keeping up with the literature" that spans innumerable journals from a broad spectrum of disciplines. In addition, this evidence-based clinical guideline has the potential to improve the appropriateness and effectiveness of patient care by basing decisions on the best evidence available. Finally, this guideline serves to identify knowledge gaps in the clinical literature on osteoporotic vertebral compression fractures in adult patients. High-quality clinical guidelines ideally identify and suggest future research topics to improve guideline development and thus patient care, as detailed in the current guideline. Recommendations were developed based on a specific definition, inclusion/exclusion criteria, and the resulting literature. This clinical guideline is not intended to be a fixed treatment protocol; it is anticipated that there will be patients who require more or less investigations or treatment than what is outlined. This clinical guideline should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any

specific procedure or treatment is to be made by the provider and patient in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution. Given the exclusion criteria, these guideline recommendations address a subset of osteoporotic vertebral compression fracture care as opposed to osteoporotic vertebral compression fracture care in its entirety. The complete clinical guideline summarized in this article, along with extensive descriptive narratives on each topic outlining the evidence and the work group rationale for the answers to each question, can be found on the NASS website at https://www.spine.org/guidelines. [NASS Diagnosis and Treatment of Adults with Osteoporotic Vertebral Compression Fractures]

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Figure Captions

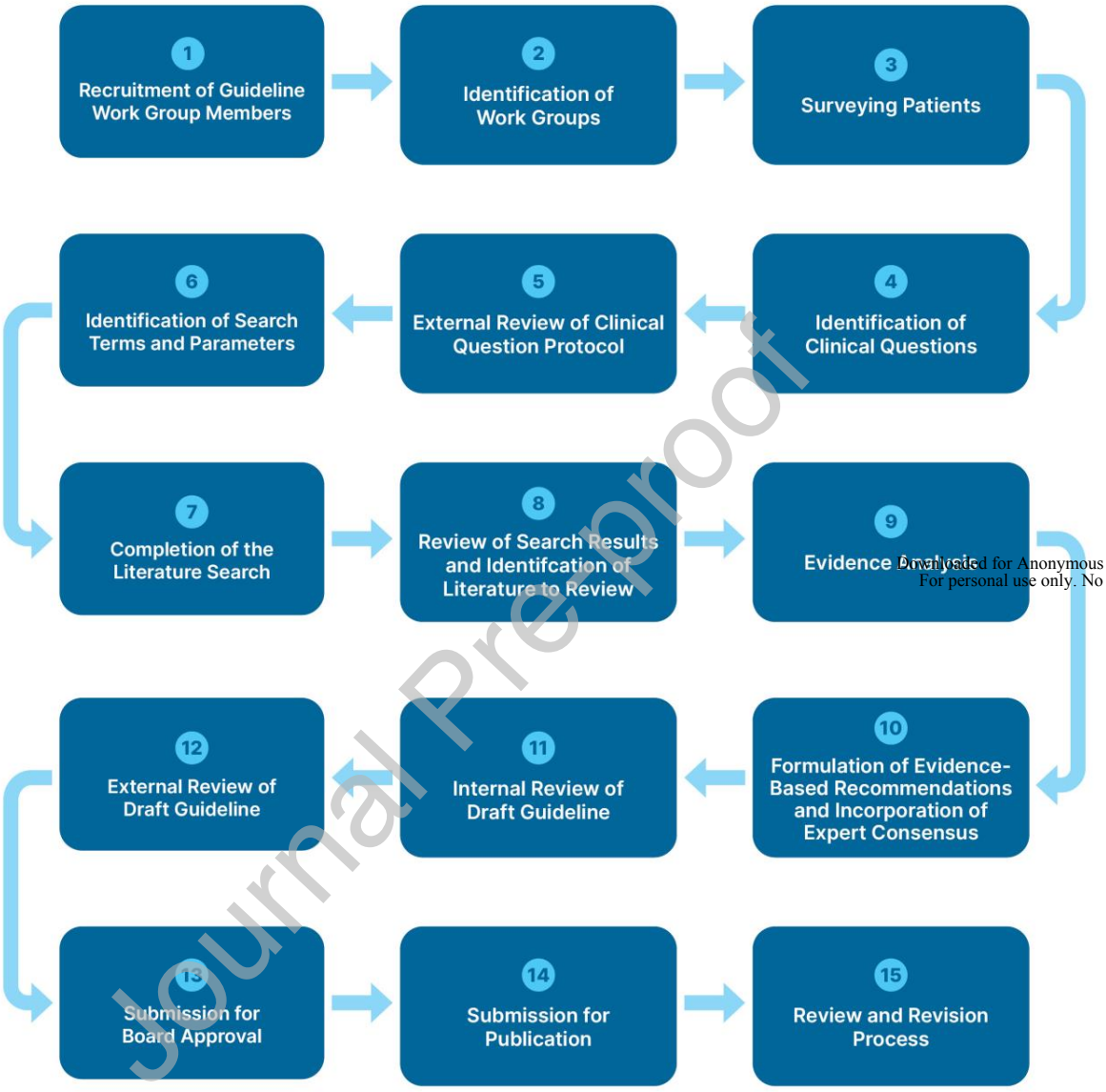

Figure 1. Summary of the North American Spine Society's guideline development process