ARISTOTLE UNIVERSITY MEDICAL SCHOOL
Thessaloniki, Hellas
Academic Orthopaedic Unit

Νεότερα για σπονδυλοδεσία - Σπονδυλοπλαστική - Κυφοπλαστική

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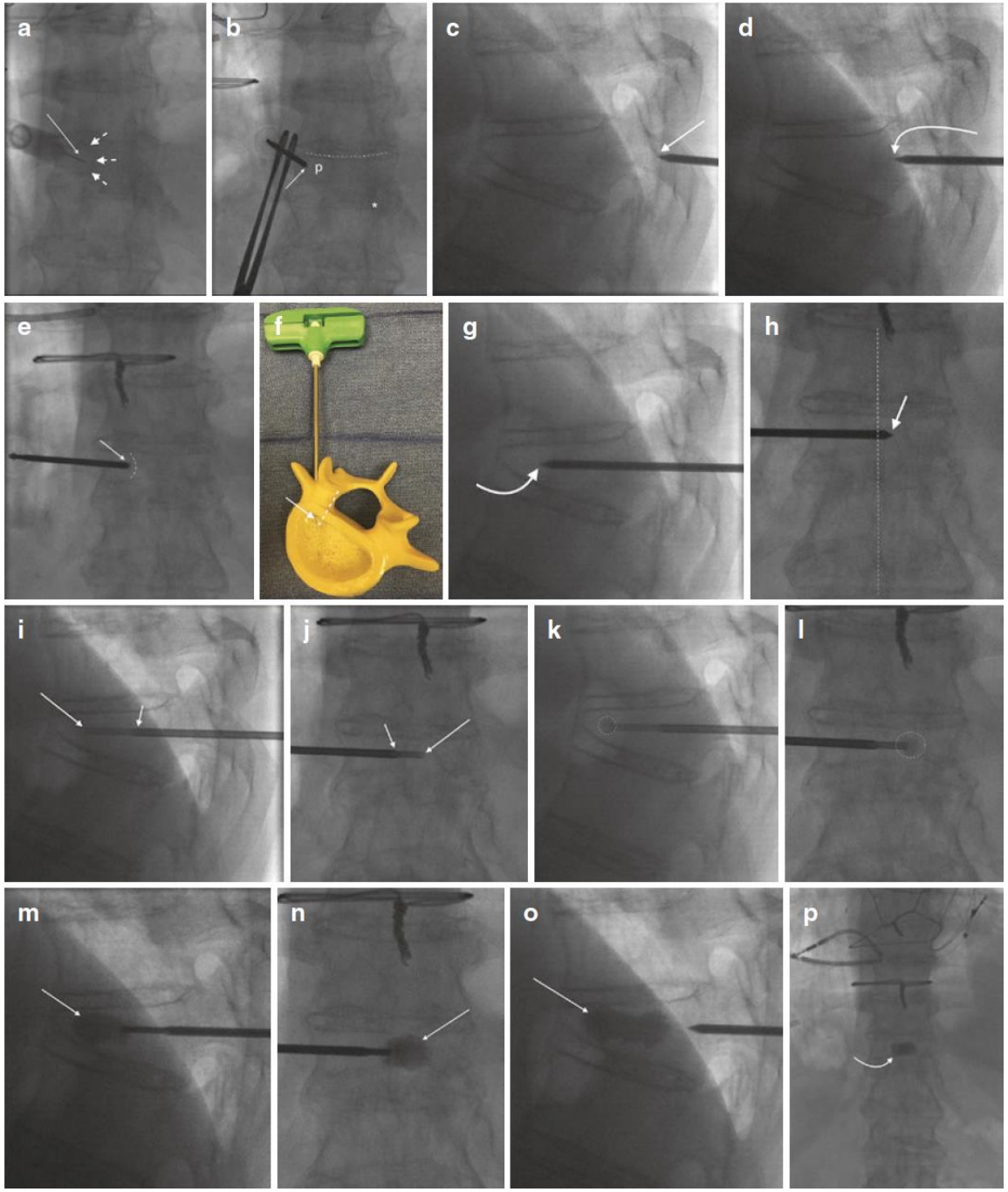
Goals of treatment for VCFs

- Primary: pain relief
  restoration of vertebral body height
- Secondary: preservation of the independence of the patient
  protection of pulmonary function
  avoidance of medical complications after fracture
- several treatment options available

Pfeifer M, et al. Am J Phys Med Rehabil. 2004;83(3):177–86.

Vertebroplasty

- France in 1987 symptomatic vertebral hemangioma
- injection PMMA cement through a large needle in the vertebral body / pain relief and fracture stabilization
- unilaterally or bilaterally
- under local anesthesia at a very low cost
- does not address the spinal deformity and uses high pressure cement in a very liquid form
- greater potential for leakage outside the vertebral body



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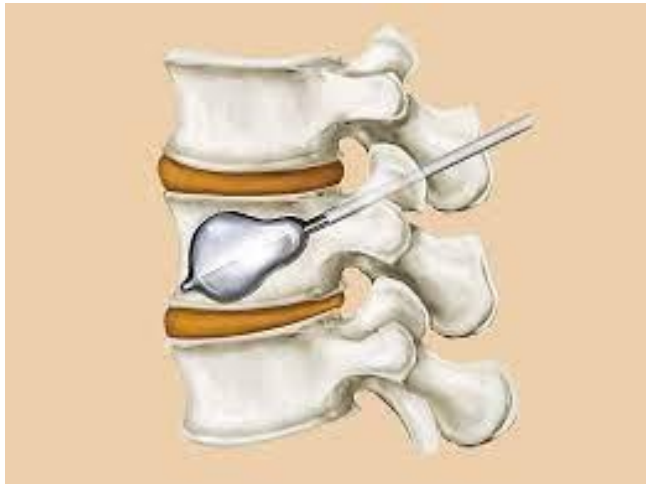
Kyphoplasty

- uses a balloon introduced into the vertebral body to create a cavity for cement implantation
- more expensive
- more technical challenging
- potential to improve the kyphotic angle of the re-expanded fractured vertebra
- cement is thicker in viscosity minimizing the risk of extrusion



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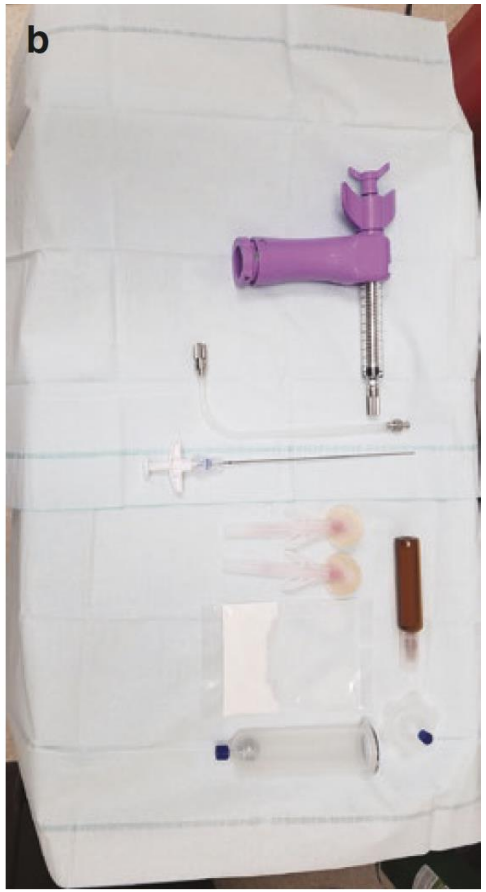
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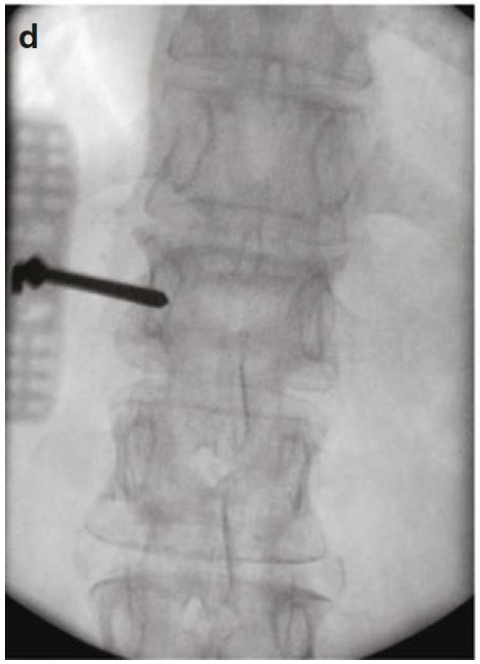
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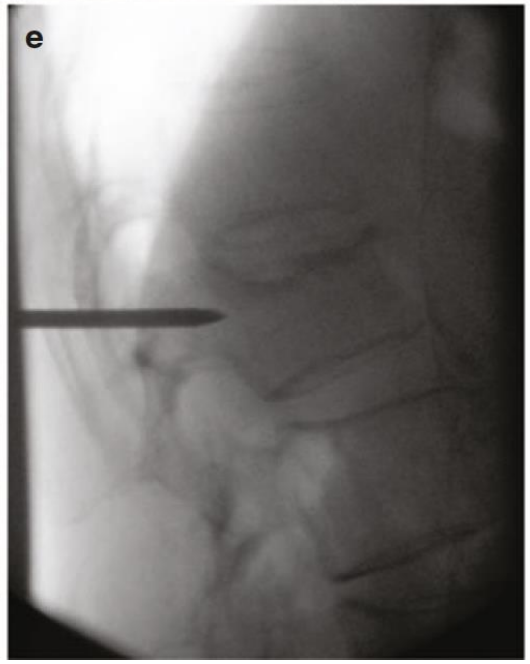
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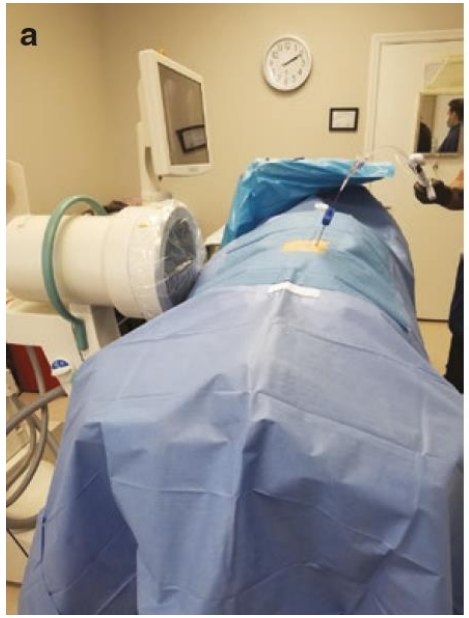
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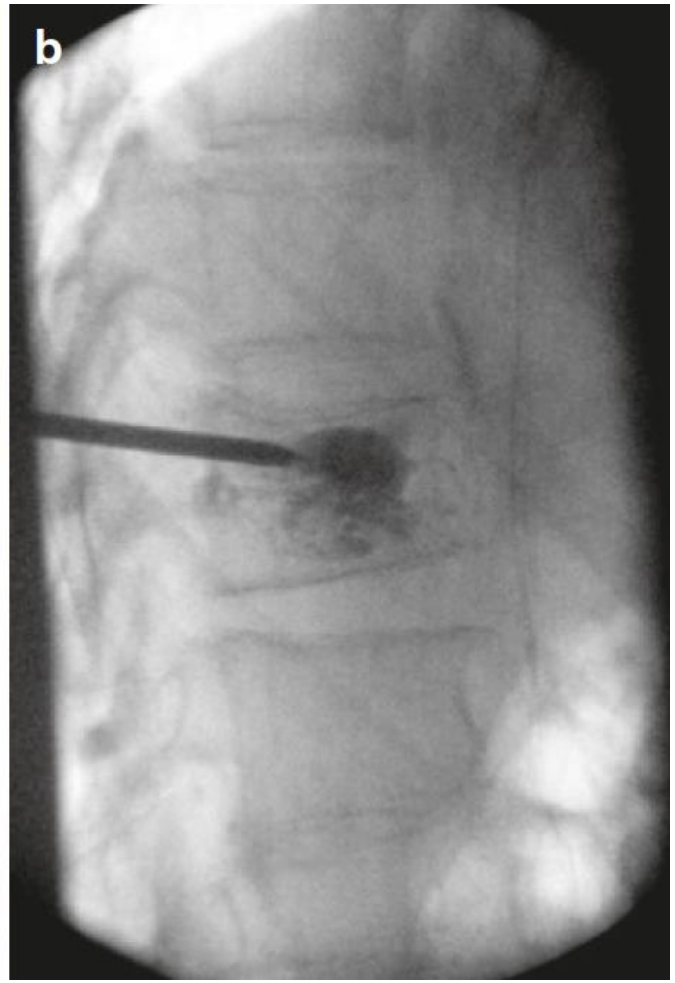
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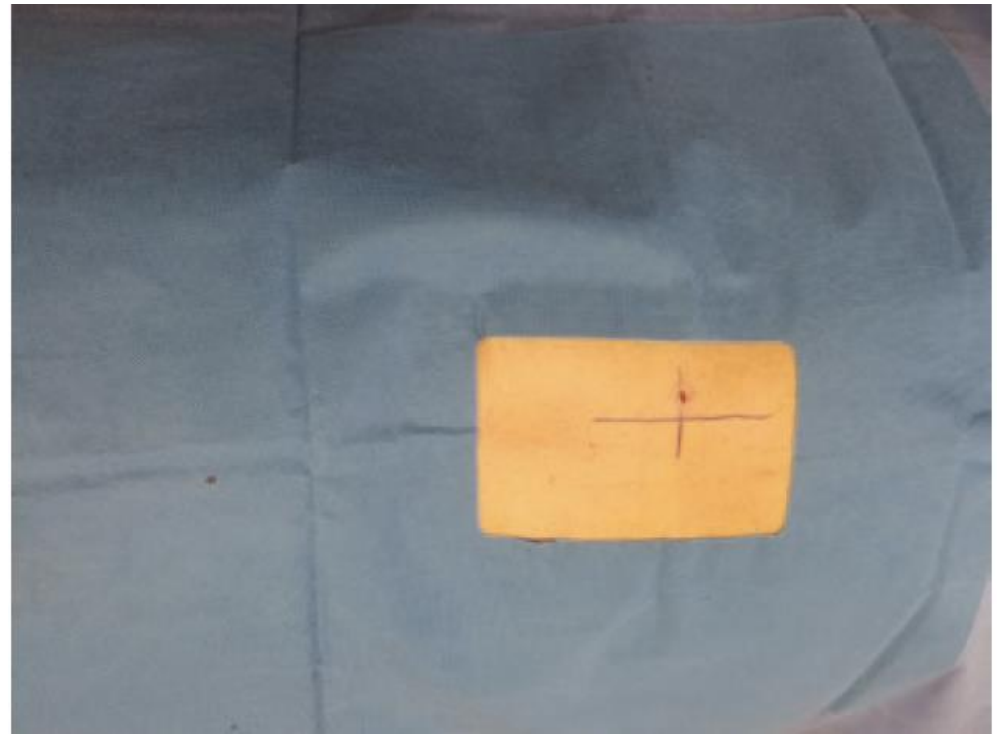


Pre-AAOS Guideline Evidence

SPINE Volume 31, Number 17, pp 1983–2001

Vertebroplasty and Kyphoplasty: A Systematic Review of 69 Clinical Studies

Paul A. Hulme, MSc,* Jörg Krebs, DVM,* Stephen J. Ferguson, PhD,* and Ulrich Berlemann, MD†

- systematic review / 69 clinical studies evaluating vertebroplasty and kyphoplasty
- no randomized at that time / very few prospective cohort studies
- 22 kyphoplasty studies: 1288 patients, 44 vertebroplasty studies: 2958 patients.
- Kyphoplasty: pain relief 92% of patients, VAS: from 7.15 to 3.4
- Vertebroplasty: 87% some pain relief, VAS: from 8.2 to 3.0.
- limited number of studies that involved the physical function

Height restoration

- Measurement techniques vary greatly in studies, difficult to compare the two techniques directly
- kyphoplasty: mean 6.6^0 kyphosis correction, 34% no appreciable improvement in height restoration
- Vertebroplasty: 5.6^0 kyphosis correction, 39% no appreciable improvement in the kyphosis
- Reported complications: predominantly cement leakage, 9% kyphoplasty /41% vertebroplasty
- Most of these cement leakages clinically asymptomatic in both groups.
- The most notable complication in both groups: the occurrence of fractures at levels next to the treated level: 15% kyphoplasty, 12.9% vertebroplasty

Afshin E. et al. Vertebral Compression Fractures in Osteoporotic and Pathologic Bone https://doi.org/10.1007/978-3-030-33861-9

Further evidence

- consistent with the findings of the Hulme study
- Eck et al. : meta-analysis comparing the two procedures

- VAS improvement 4.6 points kyphoplasty and 5.68 points vertebroplasty

- new fractures in 4.1% kyphoplasty and 7.6% vertebroplasty

- cement leakage in 7% kyphoplasty and 19.7% with vertebroplasty

Taylor RS, et al. Spine (Phila Pa 1976). 2006;31(23):2747–55.
Taylor RS, et al. Eur Spine J. 2007;16(8):1085–100. Review.
Liu et al.Osteoporos Int. 2010;21(2):359–64.
Eck JC, et al. Spine J. 2008;8(3):488–97.

In conclusion, when evaluating the data from studies comparing VP to KP

- pain relief was similar in both procedures
- Functional improvement was tied to pain relief
- cement leakage was higher for VP but, in most cases clinically irrelevant
- ability to restore height only in the first 3–6 m/ somewhat better with KP

Afshin E. et al. Vertebral Compression Fractures in Osteoporotic and Pathologic Bone https://doi.org/10.1007/978-3-030-33861-9

KP and VP to conservative management

RESEARCH

Clinical outcomes after acute osteoporotic vertebral fractures: a 2-year non-randomised trial comparing percutaneous vertebroplasty with conservative therapy

Terrence H Diamond, Carl Bryant, Lois Browne and William A Clark

- nonrandomized trial

- earlier improvement in pain scores and physical function in VP patients vs control group

- benefits within 24 hours, more rapid rehabilitation and lower complication rate

- the benefits only short term – after 6 weeks, similar outcomes than the control group

Efficacy and safety of balloon kyphoplasty compared with non-surgical care for vertebral compression fracture (FREE): a randomised controlled trial

Douglas Wardlaw, Steven R Cummings, Jan Van Meirhaeghe, Leonard Bastian, John B Tillman, Jonas Ranstam, Richard Eastell, Peter Shabe, Karen Talmadge, Steven Boonen

Lancet 2009; 373: 1016–24

Summary

Background Balloon kyphoplasty is a minimally invasive procedure for the treatment of painful vertebral fractures,

- Randomized trial comparing KP to non-operative management

- KP better than non-operative treatment concerning pain improvement and functional outcomes at 1 month

- those improvements were less apparent at 12 months.

ELSEVIER

The Spine Journal 9 (2009) 501–508

THE SPINE JOURNAL

Review Articles

Vertebroplasty and kyphoplasty for the treatment of vertebral compression fractures: an evidenced-based review of the literature

Matthew J. McGirt, MD*, Scott L. Parker, BS, Jean-Paul Wolinsky, MD, Timothy F. Witham, MD, FACS, Ali Bydon, MD, Ziya L. Gokaslan, MD, FACS

Spinal Column Biomechanics and Surgical Outcomes Laboratory, The Johns Hopkins Department of Neurosurgery, 600 N. Wolfe Street, Meyer 8-161, Baltimore, MD 21218, USA

Received 6 September 2008; accepted 10 January 2009

- systematic review
- level 1 evidence VP and KP compared non-operative treatment

- better results in the first 2 weeks after the procedure

- level 2 and 3 evidence: improved pain at 6 months, but no study showed overwhelming differences between conservative and surgical management after that period.

AAOS Guidelines

- met in 2009 and 2010 to evaluate the existing body of published evidence
- resulting guidelines were published in 2011
- very few level 1 studies which could be used to develop these guidelines.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

A Randomized Trial of Vertebroplasty for Painful Osteoporotic Vertebral Fractures

Rachelle Buchbinder, Ph.D., Richard H. Osborne, Ph.D., Peter R. Ebeling, M.D., John D. Wark, Ph.D., Peter Mitchell, M.Med., Chris Wriedt, M.B., B.S., Stephen Graves, D. Phil., Margaret P. Staples, Ph.D., and Bridie Murphy, B.Sc.

- multicentre, randomized, double-blind, placebo-controlled study
- one or two painful osteoporotic vertebral fractures, < 12 months' duration and unhealed (MRI)
- randomly assigned to undergo vertebroplasty or a sham procedure
- outcomes at 1 week and 1, 3, and 6 months/ primary outcome overall pain relief at 6 months
- 78 participants, 38 vertebroplasty, and 40 a sham procedure; 91% completed the 6-month study.
- No benefit of vertebroplasty over sham surgery at any time point

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

A Randomized Trial of Vertebroplasty for Osteoporotic Spinal Fractures

David F. Kallmes, M.D., Bryan A. Comstock, M.S., Patrick J. Heagerty, Ph.D., Judith A. Turner, Ph.D., David J. Wilson, F.R.C.R., Terry H. Diamond, F.R.A.C.P., Richard Edwards, F.R.C.R., Leigh A. Gray, M.S., Lydia Stout, B.S., Sara Owen, M.Sc., William Hollingworth, Ph.D., Basavaraj Ghdoke, M.D., et al.

- randomized, prospective, multicentred study
- patients that had failed medical treatment with fractures < 1 year
- primary outcome measures: modified disability questionnaire, and pain during the preceding 24 hours
- 1800 patients screened/ 431 eligible; 70% declined participation / 131 patients enrolled in the study
- 43% of the control group crossed over to surgery by 3 months due to unrelenting pain.
- trend toward clinically meaningful improvement in the VP group than the control group (61% vs. 48%)
- however, no statistical significance demonstrated at any point in time.

AAOS guideliness

- Based on the two studies in the New England Journal of Medicine
- recommended against vertebroplasty based on the two level 1 and three level 2 studies with a strong consensus opinion
- Strangely enough, kyphoplasty was noted to have weak support based on two level 1 studies
- When comparing kyphoplasty to vertebroplasty, three studies showed inconsistent results, and therefore, no recommendation could be made.

Post-AAOS Guidelines

ORIGINAL ARTICLE

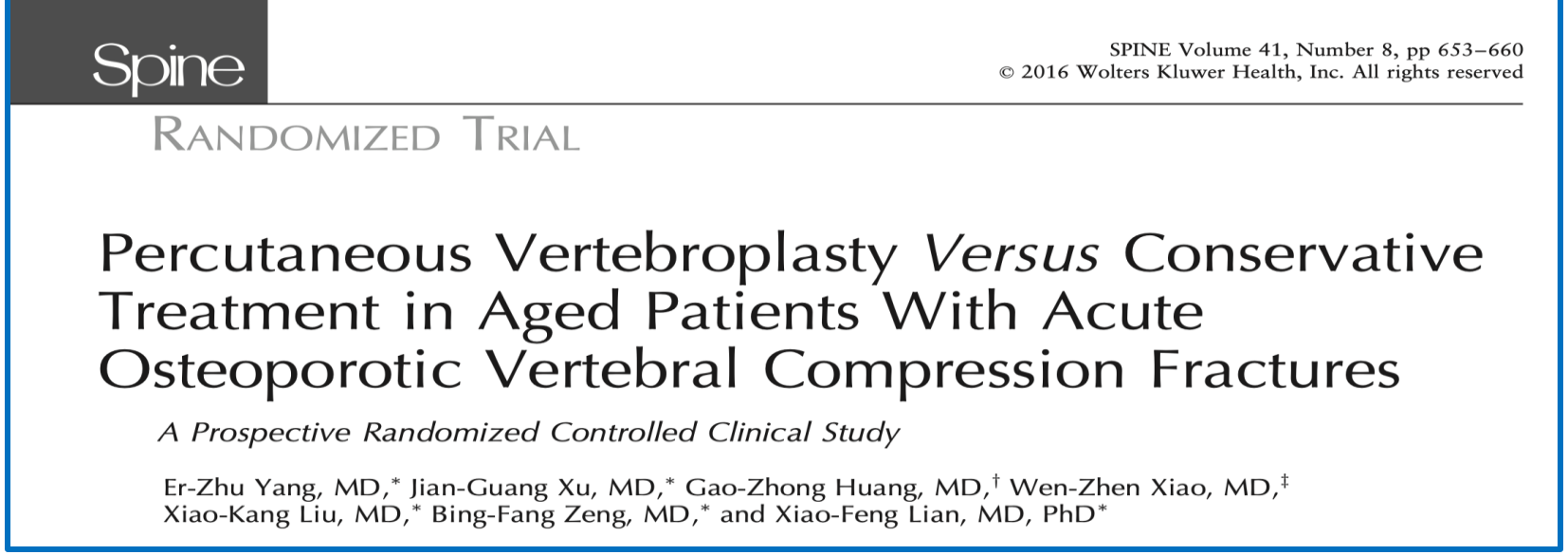
JBMR

Meta-Analysis of Vertebral Augmentation Compared With Conservative Treatment for Osteoporotic Spinal Fractures

Paul A Anderson,[1] Alexander B Froyshteter,[1] and William L Tontz Jr[2]

[1]Department of Orthopedics and Rehabilitation, University of Wisconsin, Madison, WI, USA
[2]Coastal Orthopedics, Bradenton, FL, USA

- meta-analysis of 8 prospective RCTs comparing vertebral augmentation to conservative treatment
- greater pain relief, functional recovery, QoL with cement augmentation than conservative therapy
- cement augmentation results were significant in the early (<12 w) and late time points (6 to 12 m)
- strong evidence in favour of cement augmentation in the treatment of symptomatic VCF fractures.



Spine

SPINE Volume 41, Number 8, pp 653–660

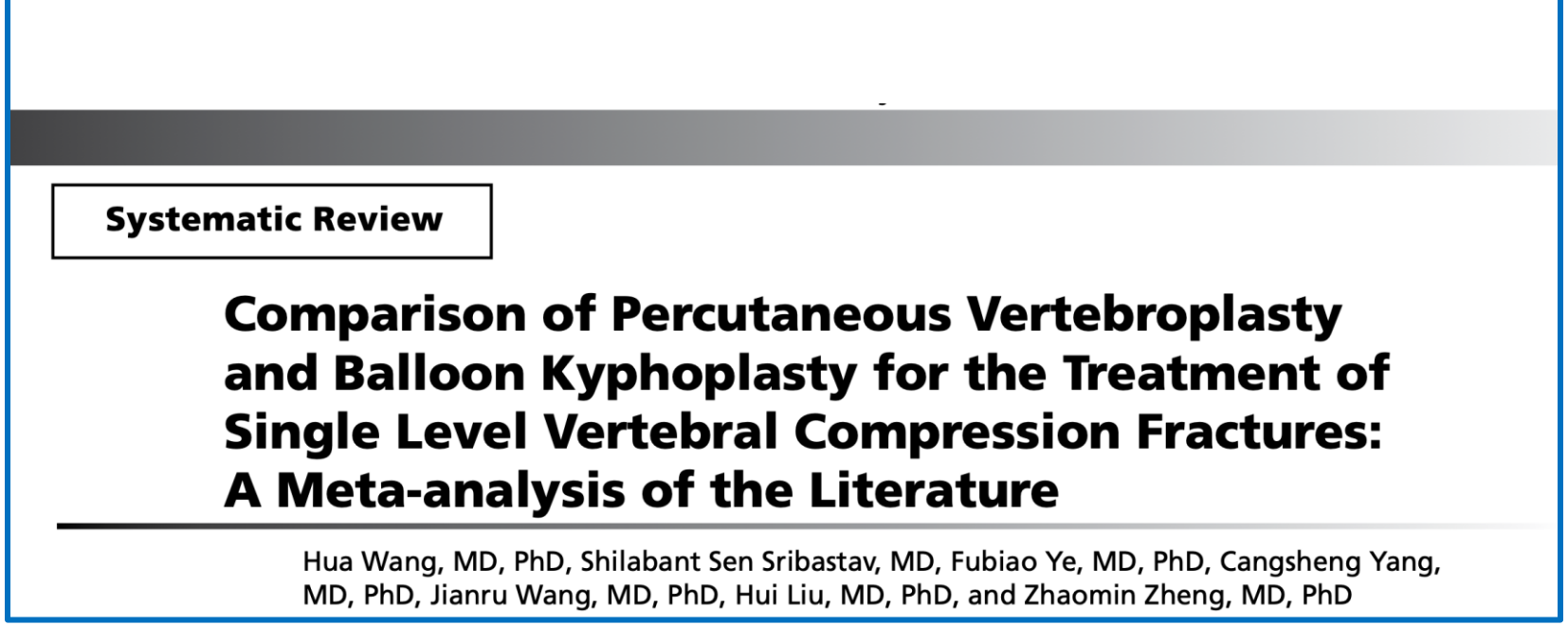
RANDOMIZED TRIAL

Percutaneous Vertebroplasty *Versus* Conservative Treatment in Aged Patients With Acute Osteoporotic Vertebral Compression Fractures

A Prospective Randomized Controlled Clinical Study

Er-Zhu Yang, MD,* Jian-Guang Xu, MD,* Gao-Zhong Huang, MD,† Wen-Zhen Xiao, MD,‡ Xiao-Kang Liu, MD,* Bing-Fang Zeng, MD,* and Xiao-Feng Lian, MD, PhD*

- 107 patients (56 in PVP group; 51 in CV group) completed 1-year follow-up
- VP performed at a mean of 8.4 ± 4.6 days after onset
- VP much greater pain relief than CV treatment at postoperative day 1 ($p < 0.0001$)
- pain relief and QoL were significantly improved in PVP group than in CV group at 1 w, 1, 3 & 6 m, and 1 year (all $p < 0.0001$)
- PVP group were significantly more satisfied with lower rate of complications ($P < 0.0001$)



Systematic Review

Comparison of Percutaneous Vertebroplasty and Balloon Kyphoplasty for the Treatment of Single Level Vertebral Compression Fractures: A Meta-analysis of the Literature

Hua Wang, MD, PhD, Shilabant Sen Sribastav, MD, Fubiao Ye, MD, PhD, Cangsheng Yang, MD, PhD, Jianru Wang, MD, PhD, Hui Liu, MD, PhD, and Zhaomin Zheng, MD, PhD

- 8 studies comparing VP vs KP for single-level compression fractures
- 845 patients
- no differences in long-term VAS scores, ODI scores, and short- or long-term SF 36 scores, or differences in adjacent segment fracture rates
- KP superior in correcting the kyphotic angle and vertebral body height than VP

recent studies ……

- VP and KP can be used to treat patients with osteoporotic compression fractures in patients who fail to improve with medical management

- Determining who will benefit from cement augmentation versus conservative treatment is an ongoing issue and warrants further research.

Afshin E. et al. Vertebral Compression Fractures in Osteoporotic and Pathologic Bone https://doi.org/10.1007/978-3-030-33861-9

recent studies ……

- literature controversies: no study provide definitive evidence: which patients will benefit most from VP/KP.
- greatest benefit following cement augmentation within the first 3 months after fracture.
- KP within 3 months of a VCF has the possibility of reducing kyphosis that resulted from the fracture.
- After 3 months, both VP/KP have a low likelihood of kyphosis correction.

Recent studies…..Patient selection

- VP/KP typically reserved for those who have not experienced relief from CVT
- For patients with incapacitating pain from acute and subacute VCFs who are unable to taper parenteral or transition to oral opioids within seven d of admission or have intolerable sedation, constipation, or delirium from opioids
- also an option for those without improvement in pain despite four to six weeks of conservative management with oral opioids and calcitonin

Patel D, et al. World J Orthop. 2022.

Careful Patient Selection

- significant mid or low back pain exacerbated by standing; the pain relieved by lying down
- physical examination: point spinal or paraspinal tenderness at the fracture level
- focal spinal pain with anterior radiation along the ribs and/or anterior abdominal wall
- patient's pain significant at least 7/10 on a numeric pain scale
- transient or no response to narcotic analgesics.
- The onset of pain acute (measured in days) or be of subacute duration (3–12 w)
- ideal candidate very active prior to fracture with recent (acute or subacute) single-level OVCF with focal severe pain that corresponds to the fracture

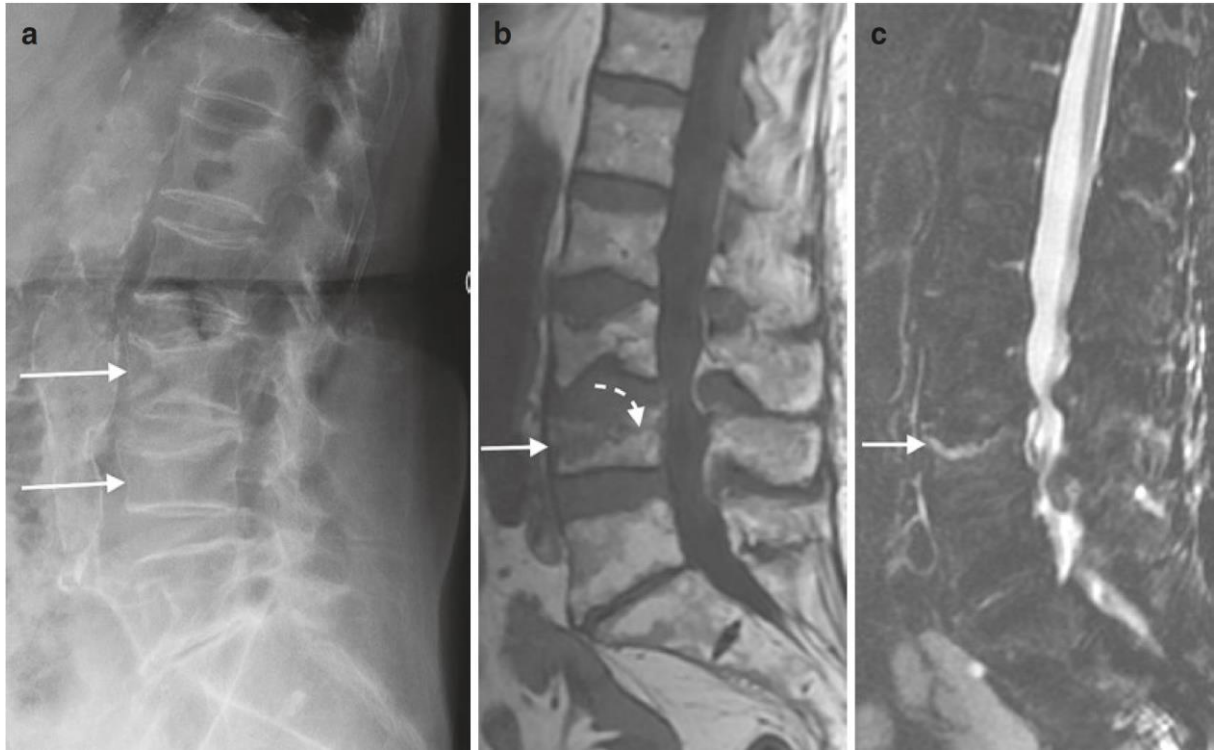
Patel D, et al. World J Orthop. 2022

The role of imaging in the evaluation of a suspected VCF is extremely important to patient selection

- MRI: the study of choice

- Acute and subacute fractures can be readily identified due to the presence of marrow oedema
  - hypointense signal on T1-weighted images
  - hyperintense signal on T2-weighted

- CT: helpful in identifying fracture lines, which may be a potential route for cement extravasation



Patel D, et al. World J Orthop. 2022

Indication	Contraindication
Painful osteoporotic vertebral compression fracture	Spinal cord compression
Painful pathologic vertebral compression fracture	Uncorrected coagulopathy
	Systemic infection
	Local infection: spine or skin
	Uncooperative patient

Patel D, et al. World J Orthop. 2022

Local complication	Management strategy
Vascular injury Direct: needle puncture Epidural hematoma Paraspinal hematoma Subcutaneous hematoma Indirect: coagulopathy	1. Review pre-op imaging 2. Use of fluoro-guided needle targeting 3. Check coagulation studies prior to the procedure 4. Use transient hold or bridging strategies for anticoagulants and antiplatelet medications 5. Monitor patients after their procedures and do examine their backs 6. Order emergent MRI for suspected epidural hemorrhage or CT for extra-spinal hemorrhage; check hematologic and coagulation profiles immediately
Neural injury Direct: needle puncture of nerve or spinal cord; dural puncture Indirect: mass effect from cement extravasation or hematoma	1. Review pre-op imaging to plan needle size and trajectory 2. Optimize patient position and fluoroscopy 3. Monitory needle insertion and advancement in multiple planes; respect the medial pedicle cortex 4. Monitor cement injection
Infection Cellulitis Infectious spondylitis	1. Strict aseptic technique 2. Pre-procedure antibiotic prophylaxis 3. Immediate patient follow-up for pain/fever 4. Order MRI with contrast and/or appropriate nuclear medicine study if patient cannot undergo MRI examination 5. Initiate antibiotic therapy if necessary
Intra-diskal cement	1.Review pre-op imaging and assess for endplate defects that may predispose to intra-diskal cement leak 2. Use high-viscosity cement
Others	
Pneumothorax Fragility fractures Ribs Sternum	Use proper targeting in the thoracic spine and at the thoracolumbar junction Careful patient transport and positioning
Systemic complication	**Management strategy**
Pulmonary embolism Cement Marrow fat	1.Use fluoroscopy when injecting cement 2. Use high-viscosity (thick) cement 3. Monitor patient's respiratory status just before, during, and after the procedure
Others	
Anesthesia complications Cardiovascular collapse Anaphylactic reaction to PMMA cement	1. Pre-operative anesthesia evaluation and use of American Society of Anesthesiology classification criteria 2. Use of local anesthetic only in very ill patients with multiple comorbidities

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Tricks

- a learning curve to reach maximal efficiency/safety with reproducible good results

European Spine Journal (2023) 32:38–45
https://doi.org/10.1007/s00586-022-07479-2

REVIEW ARTICLE

Does kyphoplasty affect the global sagittal alignment in patients with osteoporotic vertebral fractures? A systematic review and meta-analysis

Elie Najjar[1] · Ali Mardashti[1] · Spyridon Komaitis[1] · Faris Karouni[1] · Arvind Vatkar[1] · Nasir A. Quraishi[1]

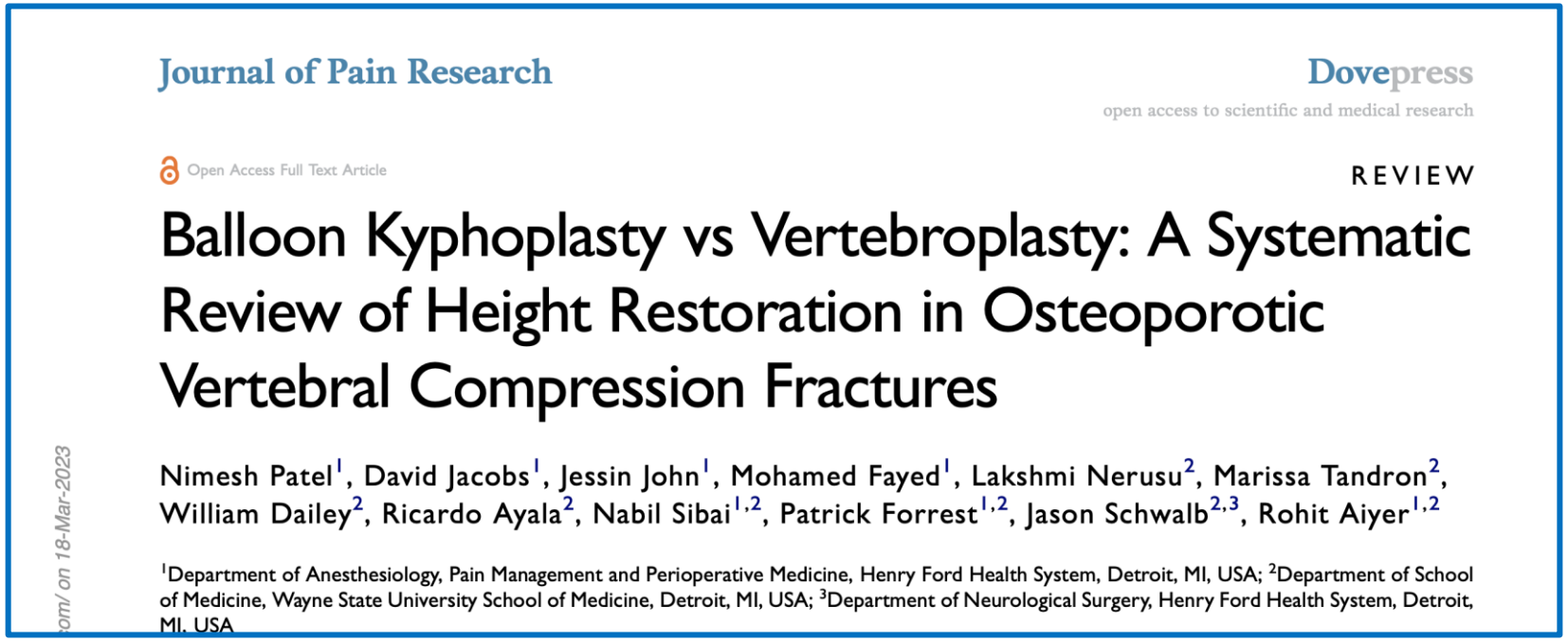
- **Objective:** the influence of BKP on the global spinal sagittal alignment using: Pelvic Incidence (PI), Pelvic Tilt (PT), Lumbar Lordosis (LL), Thoracic Kyphosis (TK), Sagittal Vertical Axis (SVA) and Spinosacral Angle (SSA)

- **Methods:** A systematic review of the English language literature PRISMA guidelines.

- **Results:**

- 4 studies met the inclusion criteria (4 level III evidence)
- 201 patients , mean age 73.8 years, acute OVCF of one or > vertebra/ number of fractured vertebrae 235
- no statistical difference in PT (24.1° vs. 23.5°, P = 0.93), TK (42.3° vs. 42.4°, P = 0.57), PI-LL (14.4° vs.12.4°, P = 0.4), SVA (6.1 cm vs. 5.5 cm, P = 0.19) SSA (114.8° vs. 116.7° P = 0.36). VAS was significantly reduced post BKP (7.1 vs. 2.5 P = 0.004).

- **Conclusion:** Performing BKP does not significantly affect the global sagittal alignment in patients with OVCFs



Journal of Pain Research

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REVIEW

Balloon Kyphoplasty vs Vertebroplasty: A Systematic Review of Height Restoration in Osteoporotic Vertebral Compression Fractures

Nimesh Patel[1], David Jacobs[1], Jessin John[1], Mohamed Fayed[1], Lakshmi Nerusu[2], Marissa Tandron[2], William Dailey[2], Ricardo Ayala[2], Nabil Sibai[1,2], Patrick Forrest[1,2], Jason Schwalb[2,3], Rohit Aiyer[1,2]

[1]Department of Anesthesiology, Pain Management and Perioperative Medicine, Henry Ford Health System, Detroit, MI, USA; [2]Department of School of Medicine, Wayne State University School of Medicine, Detroit, MI, USA; [3]Department of Neurological Surgery, Henry Ford Health System, Detroit, MI, USA

- **Purpose of review:** This systematic review comprehensively compared balloon KP and VP with respect to height restoration and pain relief.

- **Recent findings:** PRISMA guidelines / 33 RCTs; 20 reviewed balloon KP, 7 reviewed VP, and 6 compared VP to balloon KP.

- Both treatments restored some vertebral body height and showed benefits in pain reduction and improved patient-reported functionality.

- **Summary:** Balloon KP and VP are effective treatments for vertebral compression fractures and this review suggests that balloon KP may be favored for vertebral height restoration. Further studies are needed.

Vertebroplasty versus Kyphoplasty in the Treatment of Osteoporotic Vertebral Compression Fractures: A Meta-Analysis

Mohammad Daher[1], Gaby Kreichati[1,2], Khalil Kharrat[1,2], Amer Sebaaly[1,2]

- **Background:** 1) vertebroplasty and 2) kyphoplasty (KP) no clear consensus on which is the better

- **Methods:** PubMed, Cochrane, and Google Scholar up to October 2022.

  - Only 8 studies were included in the meta-analysis.

  - The clinical outcomes complications (cement leakage, adjacent level fractures), the VAS and ODI scores, kyphotic wedge angle, and vertebral body height restoration.

- **Results:** KP was shown to be superior to VP to reduce cement leakage and increase postoperative vertebral body height. The comparison of the rest of the outcomes was statistically insignificant between both techniques.

- **Conclusions:** Although KP could significantly increase postoperative vertebral body height and decrease the risk of cement leakage, the fact that it is more costly and has a longer operative time raises the question about the cost effectiveness of the procedure.

REVIEW ARTICLE

Royal Australasian College of Surgeons

Vertebroplasty with high-viscosity cement versus conventional kyphoplasty for osteoporotic vertebral compression fractures: a meta-analysis

Yu-hui Kou,*† Dian-ying Zhang,*†‡§ Jin-dong Zhang,§ Na Han†‡¶ and Ming Yang *†

- **Background/ Methods::** percutaneous VP with high viscosity cement (PVP-HVC) and percutaneous KP (PKP) with normal-viscosity cement in patients with OVCFs up to July 2021
- **Results:** 12 studies, embracing 1050 patients with OVCFs
- PVP-HVC was superior to PKP with normal-viscosity cement regarding risk of cement leakage (RR: 0.67, 95% CI: 0.54-0.83) and operation time (WMD: -11.26, 95% CI: -14.78 to -8.34).
- PKP groups had a significant decrease in Cobb's angles postoperatively (within 1 m, 95% CI: 1.85-3.48; after 1 y, 95% CI: 1.35-4.01)
- No significant differences between the procedures pertaining to injected cement volume, VAS, ODI and risk of adjacent VFs.
- **Conclusion:** both are safe and effective treatments for the management of OVCF, but the former is superior to the latter in terms of procedure time. The potential of PVP-HVC in reducing cement leaks remains to be validated by more well-designed studies.

- **Background:** High viscosity (HVC) and low viscosity cement (LVC) have been used to treat OVCFs
- **Results:** 12 randomized trials.
- The 2 groups had similar changes in terms of bone cement injection volume, ODI and adjacent VFs.
- The HVC group showed shorter operation time and better VAS score improvement
- The bone cement leakage rate of the HVC group was significantly better than LVC group ($P < .00001$), in the leakages of the veins ($P < .00001$), the intervertebral disc ($P < .00001$), the paravertebral area ($P = .003$) and the intraspinal space ($P = .03$)
- **Conclusions:** In terms of bone cement injection volume, ODI and adjacent vertebral fractures, the 2 group are equivalent. HVC had a shorter operation time, lower bone cement leakage rate and better VAS score improvement, compared with LVC.

Robot Versus Fluoroscopy-Assisted Vertebroplasty and Kyphoplasty for Osteoporotic Vertebral Compression Fractures: A Systematic Review and Meta-analysis

Yu Zhang[1], Qing Peng[1], Chenhao Sun[1], Xiaohe Kang[1], Man Hu[2], Wenjie Zhao[2], Xin Liu[1], Bo Meng[2], Sheng Yang[2], Xinmin Feng[1], Liang Zhang[1]

- **Objective:** clinical results and complications of robot-assisted (RA) versus fluoroscopy-assisted (FA) percutaneous vertebral augmentation (PVA) in the treatment of OVCFs
- **Results:** RA-PVA had a significantly lower bone cement leakage rate, shorter fluoroscopy frequency, and shorter radiation exposure time compared with FA-PVA
- No significant differences were found between RA-PVA and FA-PVA in operative time
- no statistically differences were found between the 2 groups in VAS and ODI scores postoperatively
- **Conclusions:** This meta-analysis showed that RA-PVA can reduce bone cement leakage rate, fluoroscopy frequency, and doctors' radiation exposure time. we anticipate more high-quality randomized controlled trials of RA versus FA-PVA in the future

International Journal of Surgery 101 (2022) 106632

Contents lists available at ScienceDirect

International Journal of Surgery

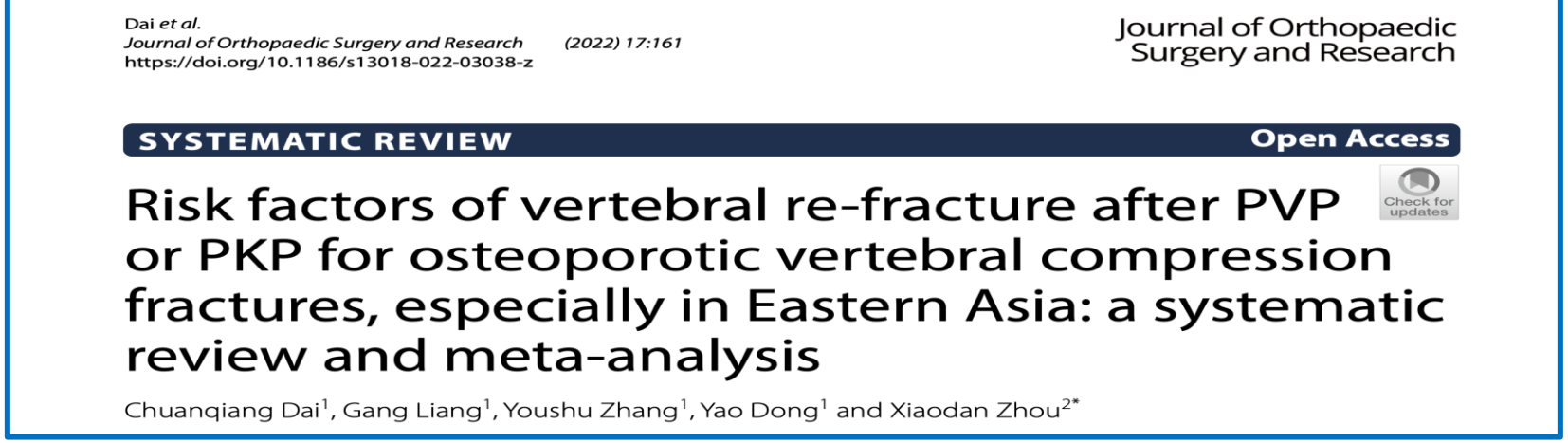
journal homepage: www.elsevier.com/locate/ijsu

Review

Risk factors for pulmonary cement embolism associated with percutaneous vertebral augmentation: A systematic review and meta-analysis

Hai-Bo Sun [a], Xiao-Shan Jing [b], Jian-Lin Shan [a], Li Bao [a], De-Cheng Wang [c], Hai Tang [a,*]

- **Background:** Pulmonary cement embolism (PCE) was a rare but fatal complication for PVA
- **Methods:** PubMed, EMBASE, Cochrane library, Google Scholar, web of science, ClinicalTrial.gov to 2021.
- **Results:** 13 studies. According NOS, 7 studies were considered as low quality, with NOS< 6. The others were of relatively high quality, with NOS≥6
- 144/6251 patients (2.3%) had PCE after PVA. percutaneous vertebroplasty (PVP) ($P < 0.01$), thoracic vertebra ($P < 0.01$), higher cement volume injected per level ($P = 0.01$), more than three vertebrae treated per session ($P < 0.01$), venous cement leakage ($P < 0.01$) were more likely to cause PCE.
- **Conclusion:** This study showed that risk factors for PCE included PVP, thoracic vertebra, higher cement volume injected per level, more than three vertebrae treated per session, venous cement leakage.



Dai *et al.*
Journal of Orthopaedic Surgery and Research (2022) 17:161
https://doi.org/10.1186/s13018-022-03038-z

Journal of Orthopaedic Surgery and Research

SYSTEMATIC REVIEW Open Access

Risk factors of vertebral re-fracture after PVP or PKP for osteoporotic vertebral compression fractures, especially in Eastern Asia: a systematic review and meta-analysis

Chuanqiang Dai[1], Gang Liang[1], Youshu Zhang[1], Yao Dong[1] and Xiaodan Zhou[2*]

- **Methods:** Relevant literatures up to November 2021 were collected from PubMed, Embase and Web of Science.
- **Results:** 23 studies, 9372 patients with OVCF. 1255 patients (13.39%) suffered re-fracture after PVP/PKP surgery.
- 22 studies were from Eastern Asia and only 1 study was from Europe.
- Female sex ($P = 0.006$), older age ($P = 0.001$), lower BMD ($P < 0.001$) and bone cement leakages ($P < 0.001$) increased the risk of SVCF
- Compared with the unfractured group, anterior-to-posterior vertebral body height ratio ($P = 0.037$) and VAS score ($P = 0.022$) were higher in the refracture group, and kyphotic angle correction ratio ($P = 0.008$) was smaller in Eastern Asia.
- **Conclusion:** The main factors associated with re-fracture after PVP/PKP are sex, age, bone mineral density, AP ratio, Cobb ratio, VAS score, bone cement leakage and anti-osteoporosis treatment, especially in Eastern Asia.

Chen *et al.*
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Journal of Orthopaedic Surgery and Research

SYSTEMATIC REVIEW Open Access

Can facet joint block be a complementary or alternative therapeutic option for patients with osteoporotic vertebral fractures: a meta-analysis

Zhi Chen[1], Chenyang Song[1], Jianwen Chen[2], Jun Sun[3] and Wenge Liu[1*]

- **Background:** Recently facet joint block has been increasingly used to relief the residual pain after VA, but whether it can be a complementary or alternative to vertebral augmentation remain largely unknown.
- **Methods:** Embase, PubMed, Web of Science, Wanfang Data and Chinese BioMedical Literature Database
- **Results:** 10 studies
- 7 studies comparing combined therapy with VA, the results showed combined therapy was associated with significantly lower VAS scores and lower ODI scores on postoperative day 1, 7, month 1, 3.
- Three studies comparing facet joint block with vertebral augmentation, the results demonstrated vertebral augmentation only provided better analgesia in month 1 after surgery, but associated with a higher incidence refracture.
- **Conclusions:** Current evidence suggested facet joint block might be considered as a complementary to vertebral augmentation in the treatment of OVCF, but it might not be effectively used as an alternative therapy.

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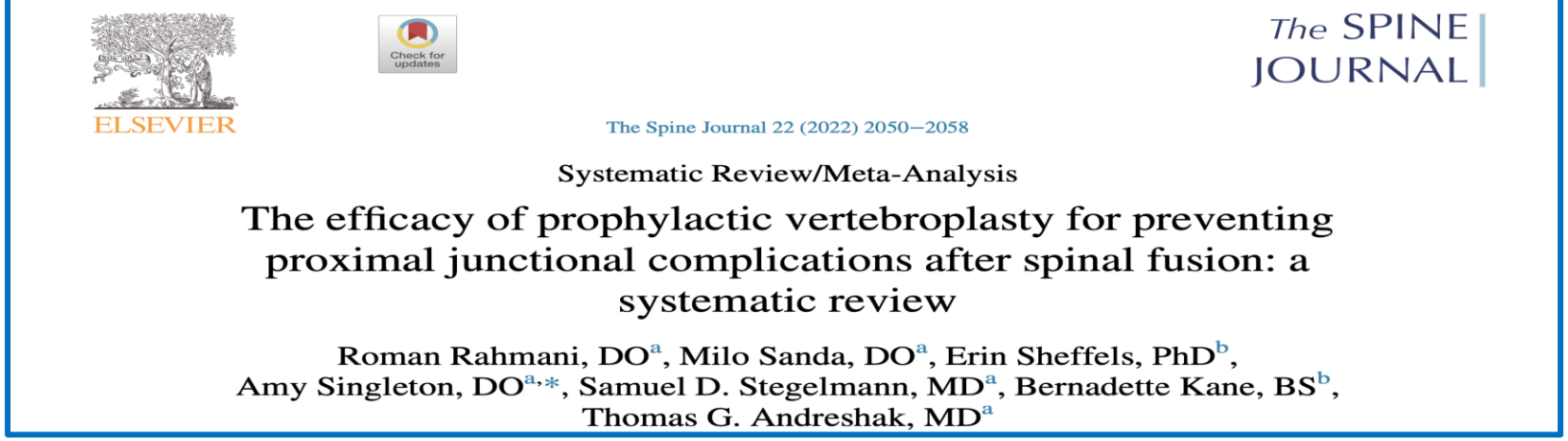
https://doi.org/10.1007/s00402-022-04392-7

ORTHOPAEDIC SURGERY

The role of routine transpedicular biopsies during kyphoplasty or vertebroplasty for vertebral compression fractures in the detection of malignant diseases: a systematic review

Georg Osterhoff[1] · Max J. Scheyerer[2] · Ulrich J. A. Spiegl[1] · Klaus J. Schnake[3,4]

- **Introduction:** systematically summarize the existing knowledge on the value of routine transpedicular biopsies during KP/VP for VCFs.
- **Methods:** PubMed/Medline databases
- **Results:** 16 articles, 6 prospective and 10 retrospective from 2005 to 2020, 3083 patients, 3667 transpedicular biopsies
- Most biopsies confirmed osteoporosis as the dominant underlying pathology of VCFs.
- Transpedicular biopsies revealed an unexpected malignant diagnosis in 0.4-6% of the cases.
- **Conclusion:** The evidence to support a routine biopsy is inconsistent. Nevertheless, routine biopsies can be considered, especially when sufficient preoperative imaging is not available or radiological findings are unclear.



ELSEVIER

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The SPINE JOURNAL

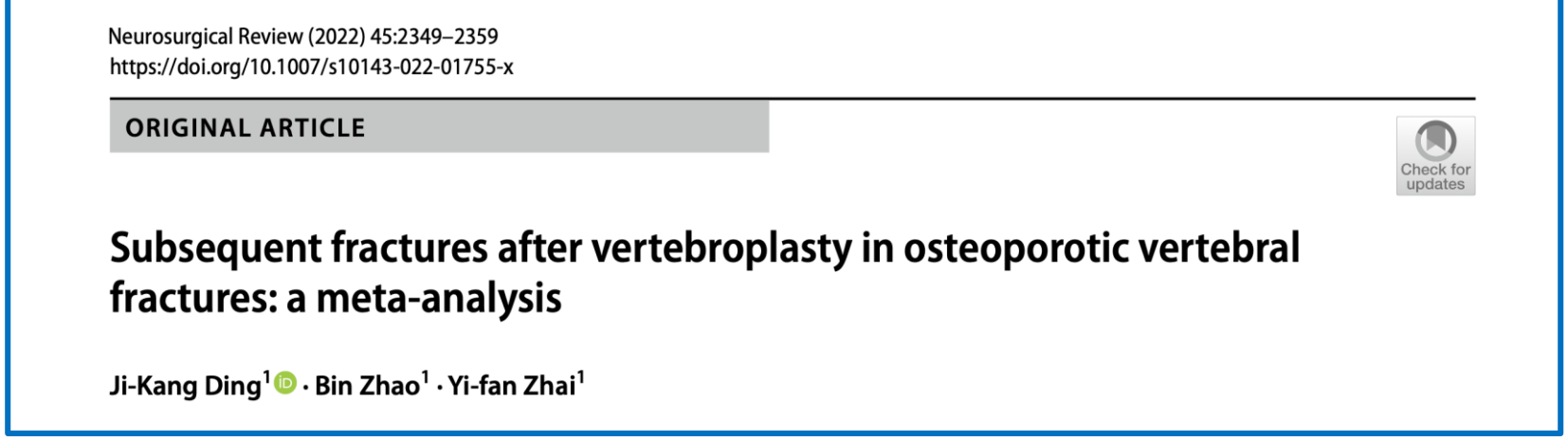
The Spine Journal 22 (2022) 2050–2058

Systematic Review/Meta-Analysis

The efficacy of prophylactic vertebroplasty for preventing proximal junctional complications after spinal fusion: a systematic review

Roman Rahmani, DO[a], Milo Sanda, DO[a], Erin Sheffels, PhD[b], Amy Singleton, DO[a,*], Samuel D. Stegelmann, MD[a], Bernadette Kane, BS[b], Thomas G. Andreshak, MD[a]

- **Background**: Prophylactic VP is performed at the upper level of instrumentation during spinal fusion to reduce the risk of proximal junctional kyphosis (PJK), proximal junctional fracture (PJFx), and proximal junctional failure (PJF)
- **Methods:** A PRISMA-compliant systematic literature review, PubMed/MEDLINE, Cochrane, and Embase. 2001 to 2021
- **Results:** 8 studies, 685 patients (VP: 293 [42.8%]; No VP: 392 (57.2%), 5 studies were comparative and 3 single-arm
- PJK incidence was reported in 5 studies (3 comparatives, 2 single-arm) and ranged from 7.9% to 46.4%; incidence was lower in patients with VP in two of three (66.7%) comparative studies, and equal in one of three (33.3%)
- PJFx was reported in 5 studies (4 comparatives, 1 single-arm) and ranged from 0.0% to 39.3%; incidence was lower in the VP group in 2/4 (50.0%) comparative studies, equal in 1/4 (25.0%), and higher in 1/4 (25.0%)
- PJF was reported in 5 studies (3 comparatives, 2 single-arm) and ranged from 0.0% to 39.3%; incidence was lower in the VP group in two of three (66.7%) comparative studies and equal in one of three (33.3%).
- **Conclusions:** Evidence is inconclusive and conflicting. Further research is needed



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ORIGINAL ARTICLE

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Subsequent fractures after vertebroplasty in osteoporotic vertebral fractures: a meta-analysis

Ji-Kang Ding[1] · Bin Zhao[1] · Yi-fan Zhai[1]

- meta-analysis on the incidence of subsequent fractures after VP in patients with OVCF.
- PubMed and EMBASE
- original articles reporting on new fracture rates after VP in OVCF patients.
- 39 studies, 8047 participants from 12 countries. Patients' age ranged 64.2 to 94.6 years, median follow-up 21 m
- Pooled estimate for subsequent fractures after VP was 23.4% ($p < 0.01$). New fractures after VP in 54.6% of cases occurred in the vertebral bodies adjacent to the treated vertebra (95% CI, 49.0-60.1%; $I^2 = 66.0\%$, $p < 0.01$).
- A significant proportion of patients undergoing VP for OVCF experience new fractures after treatment, most of which are developed in the vertebral bodies adjacent to the treated vertebra.

Percutaneous Vertebroplasty Combined with Zoledronic Acid in Treatment and Prevention of Osteoporotic Vertebral Compression Fractures: A Systematic Review and Meta-Analysis of Comparative Studies

Binbin Tang[1], Hanbing Zeng[1], Shengjia Hu[2], Kang Liu[1], Lianguo Wu[1], Xiaolin Shi[1]

- **Objective:** benefits and advantages of VP combined with zoledronic acid (ZOL) versus VP alone, to provide clinical recommendations for the treatment of OVCFs
- **Methods:** PubMed, Embase, Web of Science, and the Cochrane Library
- **Results:** 4 RCTs and 4 retrospective, 2335 cases.
- VP combined with ZOL was associated with benefits from decreased pain ($P < 0.05$), increased function ($P < 0.05$), increased BMD of the vertebral body($P < 0.05$) and of the proximal femoral neck ($P < 0.05$), fewer markers of bone metabolism (N-terminal molecular fragment: $P < 0.05$; procollagen type I N-terminal propeptide: $P < 0.05$; beta collagen degradation product: $P < 0.05$), and lower rate of refracture ($P < 0.05$).
- Patients in the vertebroplasty combined with ZOL group had greater vertebral body height ($P < 0.05$) than in the vertebroplasty group, but no differences on Cobb angle were observed ($P > 0.05$).
- **Conclusions:** VP combined with ZOL was superior to VP alone in terms of BMD, bone metabolism makers, refracture rate, pain and function.

NEUROSURGICAL FOCUS

Neurosurg Focus 50 (6):E9, 2021

Osteoporosis treatment in patients undergoing spinal fusion: a systematic review and meta-analysis

Vaidya Govindarajan, BS, Anthony Diaz, MS, Roberto J. Perez-Roman, MD, S. Shelby Burks, MD, Michael Y. Wang, MD, and Allan D. Levi, MD, PhD

- **Objective:** meta-analysis of the utility of both BPs and teriparatide in improving spinal fusion outcomes in osteoporotic patients.
- **Methods:** PubMed and Embase, 11 studies, 9 investigated BPs, 7 TPD, and 1 a combination of TPD and denosumab.
- **Results:** postop use of BPs demonstrated better odds of successful fusion as compared to that in controls during short-term monitoring (OR 3.33, $p = 0.0003$) but not long-term monitoring ($p > 0.05$). BPs use was also shown to significantly reduce the likelihood of postoperative VCF (VCF; OR 0.07, $p = 0.01$) and significantly reduce ODI scores (mean difference [MD] = -2.19, $p < 0.00001$) and VAS scores (MD = -0.58, $p < 0.00001$).
- TPD was found to significantly increase fusion rates at long-term postoperative periods as compared to rates after BPs therapy, with patients who received postoperative TPD therapy 2.05 times more likely to experience successful fusion (OR 2.05, $p = 0.01$).
- **Conclusions:** benefits of BPs and TPD therapy independently in accelerating fusion during the first 6 months after spinal fusion surgery in osteoporotic patients. TPD may have superior benefits in spinal fusion during long-term monitoring than BPs. BPs may be better suited in preventing VCFs postoperatively and minimize postoperative disability and pain.

Secondary Fracture Rate After Vertebral Osteoporotic Compression Fracture Is Decreased by Anti-Osteoporotic Medication but Not Increased by Cement Augmentation

Emily S. Mills, MD, Raymond J. Hah, MD, Zoe Fresquez, BS, Kevin Mertz, BS, Zorica Buser, PhD, MBA, Ram K. Alluri, MD, and Paul A. Anderson, MD

Investigation performed at the Keck School of Medicine, University of Southern California, Los Angeles, California

- **Background:** to determine (1) whether cement augmentation increases the rate of secondary fracture compared with nonoperative management, (2) whether anti-osteoporotic medications reduce the rate of secondary fracture, and (3) the rate of osteoporosis treatment with medications following vertebral OCF.

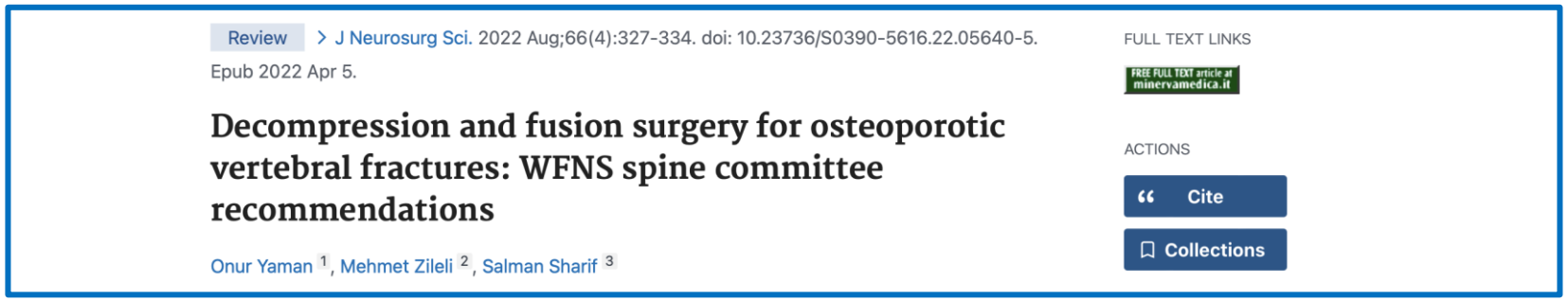
- **Methods:** The PearlDiver database was queried for all patients with a diagnosis of OCF from 2015 to 2019. Patients were excluded if they were <50 years old, had a diagnosis of spinal neoplasm or infection, or underwent lumbar fusion in the perioperative period.

- **Results:** 36,145 patients with an OCF, 25,904 (71.7%) underwent NonoM and 10,241 (28.3%) underwent CA, 1,556 VP and 8,833 KP.

- Patients with NonoM had a secondary fracture rate of 21.8% following the initial OCF, compared with 14.5% in the VP and 18.5% in the KP cohort, which was not a significant difference on multivariate analysis.

- 2,833 (7.8%) received anti-osteoporotic medications and 33,312 (92.2%) did not. The rate of secondary fracture was 10.1% in patients who received medications and 21.9% in those who did not, significant difference (OR = 1.23, $p < 0.001$).

- **Conclusions:** Cement augmentation did not alter the rate of secondary fracture, whereas anti-osteoporotic medications significantly decreased the risk of subsequent OCF by 19%. Only 7.8% of patients received anti-osteoporotic medication following the initial OCF.



- clarify the indications and types of surgeries for OVF. Medline and Pubmed 2010 and 2020
- 19 studies examining decompression and fusion surgery in OVF were reviewed
- Literature supports the statement that decompression and fusion surgery are necessary for progressive neurological deficits after OVF
- there is no consensus to choose the type of open surgery (anterior, posterior, combined, using cement or bone or vertebral body cage, the levels, and kind of instrumentation)
- implant failure in the osteoporotic spine is a common complication, and many techniques have been described to prevent implant failure in the osteoporotic spine. However, the superiority of one method over another is unclear.
- Open surgery for osteoporotic vertebral fractures should be considered if neurologic deficits and significant painful kyphosis
- The apparent indications of surgery and most ideal surgical technique for OVF remain unclear; the decision must be individualized.

Management of Osteoporotic Vertebral Fracture: Review Update 2022

- There are currently few "gold standard treatments" outlined for the management of OVFs
- Conservative treatment is the primary treatment option for OVFs.
- Numerous reports have been made on studies for vertebral augmentation (VA), including VP/KP.
- There is still debate and controversy about the effectiveness of VA in comparison with conservative treatment. Current evidence does not support the routine use of VA for OVF.
- Despite the fact that the majority of OVFs heal without surgery, 15%-35% of patients with an unstable fracture, persistent intractable back pain, or severely collapsed vertebra that causes a neurologic deficit, kyphosis, or chronic pseudarthrosis frequently require surgery
- Osteoporosis management and prevention are critical to lowering the risk of future OVFs.
- According to the available literature, there are no standard management methods for OVFs.

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