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Review Article

Osteoporotic Vertebral Fractures: Vertebroplasty and Kyphoplasty

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Background

Patients with osteoporotic vertebral compression fractures are among the most common clinical pictures in the aging spine. Depending on age, there is an unequivocal increase in incidence, especially in postmenopausal women.

The initial therapy usually consists of treatment with analgesics according to the step-by-step scheme by the World Health Organization (WHO) (1), back-friendly mobilization, if necessary, with a support corset. Close clinical and radiological follow-up appointments are recommended. Cement augmentation procedures (vertebroplasty, kyphoplasty) are usually initiated if the pain situation cannot be convincingly improved over time or if a significant pain-related mobility restriction persists. In contrast to the ongoing scientific debate, the general clinical experience after cement augmentation of the vertebra is that the patients improve most often and can be mobilized promptly.

In addition to pain, fractures can reduce the height of the vertebral bodies and thus lead to kyphotic deformities of the spine. This happens especially in the area of the thoracolumbar transition. This can provoke subsequent problems in terms of thrombosis, pulmonary embolism, reduction in muscle mass and vital capacity, secondary fractures, and chronic pain (2-4), and accordingly results in a significantly reduced quality of life and increased mortality (5).

If conservative treatment fails or if the fracture is unstable, surgical therapy methods are used. Ideally, the pain can be treated adequately with a percutaneous procedure (vertebroplasty, kyphoplasty), the corresponding vertebral body can be stabilized, and the normal alignment can be maintained, thus avoiding a kyphotic deformity (6).

Summary of the Currently Available Evidence

Since 2009, these treatment options have been studied in randomized controlled trials. Contradictory results were observed. In order to define clear recommendations for the treatment of these patients, it is of particular importance to analyze the differences between the individual studies.

As of September 2019, 14 controlled and randomized studies on "the role of cement augmentation in osteoporotic fractures" have been published (7-20). Ten of the 14 randomized studies compared non-surgical and cement augmentation procedures. Three studies compared cement augmentation procedures to sham surgery and one study compared cement augmentation to less invasive sham surgery.

In addition to the studies mentioned above in the last decade, 10 randomized studies on cement augmentation treatments for osteoporotic vertebral compression fractures have been published. The surgical therapy was compared to the best non-surgical treatment (7-9, 12-17, 20). Due to this approach, blinding was not possible. According to the criteria of evidence-based medicine, these studies have a lower level of evidence than blinded studies; on the other hand, this type of study reflects the reality of treatment, since no sham operations or interventions are carried out in everyday clinical practice. All of these studies showed better outcomes in the cement augmentation groups than in the non-surgical control groups.

The above-cited studies on cement augmentation treatment of spinal compression fractures differ very significantly in terms of the study design, the inclusion and exclusion criteria, the type of randomization, the clinical parameters recorded, the age of the fracture, and the imaging studies. In particular, some of the sham operations are more likely to represent active therapy because of how and where the local anesthetics have been applied.

A Cochrane review from 2018 (21), which was supposed to reinterpret the evidence, was criticized as being biased; this criticism was summarized in an article in the British Medical Journal in 2019 (22).

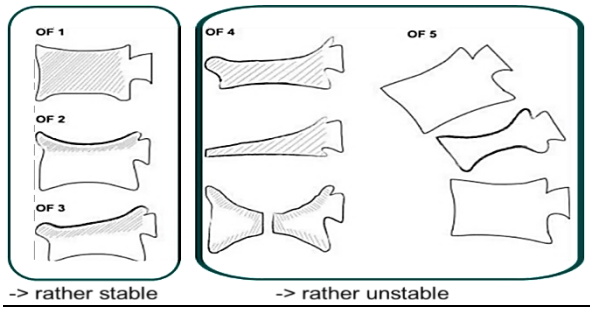

Figure 1. Classification of osteoporotic thoracolumbar spine fractures: Recommendations of the Spine Section of the German Society for Orthopedics and Trauma (DGOU), Global Spine Journal 2018, Schnake et al. (23)

Indication for Surgical versus Conservative Therapy

The indication for conservative versus surgical therapy should be discussed with the patient and/or the family using an interdisciplinary algorithm. In addition to the fracture classification per se (Figure 1), the parameters of

bone density, post-sintering of the fracture, pain, neurological deficit, degenerative changes and pre-deformity, and rigid versus non-rigid adjacent segments should be taken into account.

As well, careful consideration of the possibilities of pain-compensated mobilization under analgesia and the general health status is required.

A pseudarthrosis or instability of the fractured vertebra can be verified or ruled out using a fulcrum image or computed tomography.

A scoring system can possibly contribute to the therapy decision. This is shown in table 1 as a possible guide. This scoring system was developed and validated in connection with the osteoporotic fracture (OF) classification system (24).

Table 1. Scoring system regarding surgical/non-surgical management of osteoporotic vertebral compression fractures, Global Spine Journal, 2018, Blattert et al. (24)

Parameter	Grade	Score
Fracture classification type [OF (1-5) × 2]	1-5	2-10
Bone mineral density (T-score < -3)		1
Subsidence of the vertebra	Yes/No	1/-1
Pain (VAS)	≥4/< 4	1/-1
Neurological deficits	Yes/No	2/0
Mobilization under analgesics	No/Yes	1/-1
Health status (ASA > 3, dementia, BMI < 20, nursing case, anticoagulation)		Each: -1 Maximum: -2
Total: 0-5: conservative 6: conservative or surgical > 6: surgical		

VAS: Visual analogue scale; BMI: Body mass index; ASA: American Society of Anesthesiologists; OF: Osteoporotic fracture

Indication for Surgical Acute Treatment: Cement Augmentation Techniques with and without Instrumentation

The recommendation for surgical therapy depending on the OF classification is based on the evidence of the various cement augmentation procedures.

Fracture Type OF1: Usually conservative therapy: analgesia, local and trunk-stabilizing physiotherapy, if necessary, orthotics.

The surgical procedure of choice for the given indication is cement augmentation.

Fracture Type OF2: If conservative therapy is an option: analgesia, local and trunk-stabilizing physiotherapy, if necessary, orthotics.

The surgical procedure of choice for the given indication is cement augmentation.

Fracture Type OF3: Weighing up conservative versus operative: in case of slight kyphosis (< 15°), attempting conservative therapy is possible. In this case: analgesia, local and trunk-stabilizing physiotherapy, if necessary, orthotics.

Recommendation for surgical treatment of severe kyphosis and/or subsidence of the vertebra: in the absence of clinical and imaging (computed tomography scan/magnetic resonance imaging) signs of injury to the posterior elements of the spine and ligaments (B injury), the surgical procedure of choice is cement augmentation.

Fracture Type OF4: Recommendation for surgical therapy consists of: cement augmentation of the affected vertebral body, if necessary posterior instrumentation.

If there are contraindications to surgical therapy, the following conservative procedures should be evaluated: analgesia, local and torso-stabilizing physiotherapy, and orthotic fittings if necessary.

Fracture Type OF5: Possibilities for surgical therapy consist of: cement augmentation of the affected vertebral body, if necessary, augmentation of the connecting vertebrae and/or posterior instrumentation and spinal fusion.

If there are contraindications to surgical therapy, analgesia, local and trunk-stabilizing physiotherapy, and if necessary, orthotic fittings should be recommended.

Summary and Procedure in Exceptional Situations

The surgical procedure of choice in the case of given indication is cement augmentation for fractures of the OF1-OF3 grade. These make up the majority of osteoporotic vertebral body fractures.

Depending on the clinical symptoms and the individual osseous conditions, instrumentation with cement augmentation is a treatment alternative for the less frequent fractures of the grading OF4 and OF5 as well as some of the OF3 fractures.

In the case of fractures with neurological deficits because of neurocompression, adequate decompression should be performed.

Fractures in the ankylosing spine [Bechterew's disease or Forestier's disease, diffuse idiopathic skeletal hyperostosis (DISH)] should primarily be treated with longer multilevel instrumentation.

The cement augmentation of the connecting vertebrae to long instrumentation is an option. Pre-existing instrumentation, degeneration, deformity, or cement augmentation may necessitate an adjustment of the surgical plan.

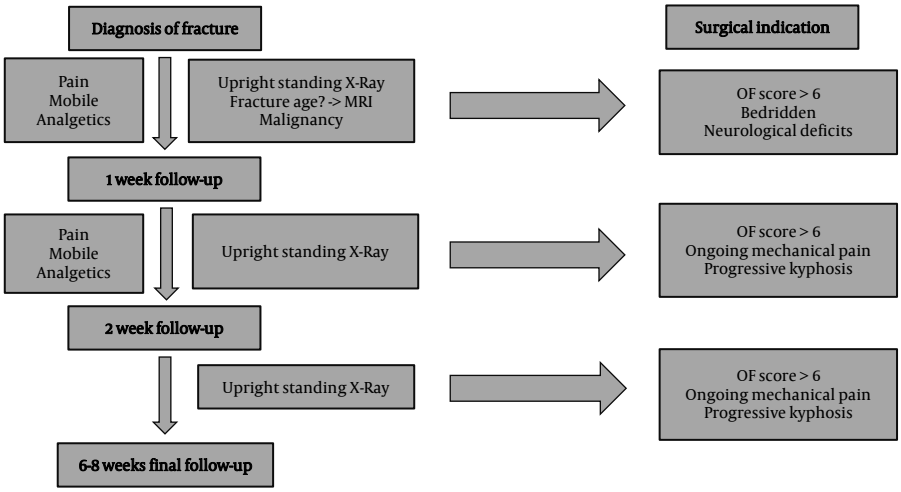

Figure 2. Therapy algorithm, taking into account the clinical symptoms and the radiological imaging

Therapy Algorithm: Taking into Account the Clinical Symptoms and the Radiological Imaging

In the case of conservative treatment, patients with OF should be monitored regularly after 1, 2, and possibly 4, 8 and, if necessary, 12 weeks, clinically and with an upright standing X-ray, so that a therapy re-evaluation (pain, fracture position) can be carried out (Figure 2).

Conclusion

Interdisciplinary algorithms should take into account the clinical symptoms and the radiological imaging. The final decision must be made individually.

Conflict of Interest

The authors declare no conflict of interest in this study.

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