

# Nonsurgical and Surgical Management of Osteoporotic Vertebral Body Fractures: Recommendations of the Spine Section of the German Society for Orthopaedics and Trauma (DGOU)

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Thomas R. Blattert, MD, PhD<sup>1</sup>, Klaus J. Schnake, MD<sup>2</sup>,  
Oliver Gonschorek, MD<sup>3</sup>, Erol Gercek, MD, PhD<sup>4</sup>,  
Frank Hartmann, MD, PhD<sup>4</sup>, Sebastian Katscher, MD<sup>5</sup>, Sven Mörk, MD<sup>6</sup>,  
Robert Morrison, MD<sup>7</sup>, Michael Müller, MD<sup>8</sup>, Axel Partenheimer, MD, PhD<sup>9</sup>,  
Stefan Piltz, MD<sup>10</sup>, Michael A. Scherer, MD, PhD<sup>11</sup>,  
Bernhard W. Ullrich, MD<sup>12</sup>, Akhil Verheyden, MD, PhD<sup>13</sup>,  
Volker Zimmermann, MD<sup>14</sup>, and  
the Spine Section of the German Society for Orthopaedics and Trauma

## Abstract

**Study Design:** Prospective clinical cohort study (data collection); expert opinion (recommendation development).

**Objectives:** Treatment options for nonsurgical and surgical management of osteoporotic vertebral body fractures are widely differing. Based on current literature, the knowledge of the experts, and their classification for osteoporotic fractures (OF classification) the Spine Section of the German Society for Orthopaedics and Trauma has now introduced general treatment recommendations.

**Methods:** a total of 707 clinical cases from 16 hospitals were evaluated. An OF classification–based score was developed to guide in the option of nonsurgical versus surgical management. For every classification type, differentiated treatment recommendations were deduced. Diagnostic prerequisites for reproducible treatment recommendations were defined: conventional X-rays with consecutive follow-up images (standing position whenever possible), magnetic resonance imaging, and computed tomography scan. OF classification allows for upgrading of fracture severity during the course of radiographic follow-up. The actual classification type is decisive for the score.

<sup>1</sup> Schwarzach Orthopaedic Clinic, Schwarzach, Germany

<sup>2</sup> Schön Klinik Nürnberg Fürth, Fürth, Germany

<sup>3</sup> BGU Trauma Center Murnau, Murnau, Germany

<sup>4</sup> Zentrum für Unfallchirurgie und Orthopädie, Gemeinschaftsklinikum Mittelrhein, Koblenz, Germany

<sup>5</sup> Interdisziplinäres Wirbelsäulenzentrum, Sana Klinikum Borna, Borna, Germany

<sup>6</sup> St. Anna Krankenhaus, Sulzbach-Rosenberg, Germany

<sup>7</sup> Sektion konservative und operative Wirbelsäulenthherapie, Klinikum Ingolstadt, Ingolstadt, Germany

<sup>8</sup> Klinik für Orthopädie und Unfallchirurgie, Universitätsklinikum Schleswig-Holstein, Kiel, Germany

<sup>9</sup> Spine & Sport, Hannover, Germany

<sup>10</sup> Orthopaedic and Trauma Surgery, Klinikum Coburg gGmbH, Coburg, Germany

<sup>11</sup> Orthopedic and Trauma Surgery, HELIOS Amper Klinikum Dachau, Dachau, Germany

<sup>12</sup> BG Klinikum Bergmannstrost, Klinik für Unfall- und Wiederherstellungschirurgie, Halle, Germany

<sup>13</sup> Klinik für Unfall-Orthopädische und Wirbelsäulenchirurgie, Ortenauklinikum Lahr-Ettenheim, Lahr, Germany

<sup>14</sup> Zentrum für Hand- und Wirbelsäulenchirurgie, Klinikum Traunstein, Traunstein, Germany

## Corresponding Author:

Thomas R. Blattert, Schwarzach Orthopaedic Clinic, Dekan-Graf-Straße 2-6, Schwarzach, D-94374, Germany.  
Email: thomas.blattert@ofks.de



**Results:** A score of less than 6 points advocates nonsurgical management; more than 6 points recommend surgical management. The primary goal of treatment is fast and painless mobilization. Because of expected comorbidities in this age group, minimally invasive procedures are being preferred. As a general rule, stability is more important than motion preservation. It is mandatory to restore the physiological loading capacity of the spine. If the patient was in a compensated unbalanced state at the time of fracture, reconstruction of the individual prefracture sagittal profile is sufficient. Instrumentation technique has to account for compromised bone quality. We recommend the use of cement augmentation or high purchase screws. The particular situations of injuries with neurological impairment; necessity to fuse; multiple level fractures; consecutive and adjacent fractures; fractures in ankylosing spondylitis are being addressed separately.

**Conclusions:** The therapeutic recommendations presented here provide a reliable and reproducible basis to decide for treatment choices available. However, intermediate clinical situations remain with a score of 6 points allowing for both nonsurgical and surgical options. As a result, individualized treatment decisions may still be necessary. In the next step, the recommendations presented will be further evaluated in a multicenter controlled clinical trial.

### Keywords

osteoporotic vertebral fracture, nonsurgical management, surgical treatment, recommendations for treatment, osteoporotic fracture classification

## Introduction

For the management of osteoporotic vertebral body fractures therapeutic strategies are widely different. Both nonsurgical and surgical options are being offered and the spectrum of indications can be very different not only between countries but also between centers.

Based on their classification for osteoporotic fractures (OF classification)<sup>1,2</sup> the Spine Section of the German Society for Orthopaedics and Trauma has now introduced general treatment recommendations that are meant to assist the individual physician in choosing the best treatment option for his or her patient. These therapeutic recommendations are the result of a consensus process of voluntary members of the Spine Section of the German Society for Orthopaedics and Trauma (DGOU) who have formed the Working Group Osteoporotic Fractures. The project was initiated in September 2010. The members of the Working Group were recruited from all over Germany and Austria and from hospitals of all levels of care. In total, there were 25 days of meetings of 16 surgeons in average discussing and developing these recommendations together.

## Materials and Methods

No institutional review board approval or approval from a similar entity was needed.

A total of 707 clinical cases from 16 hospitals were evaluated.<sup>3</sup> An OF classification-based score was developed to guide in the option of nonsurgical versus surgical management (Table 1). For every classification type, differentiated treatment recommendations were deduced. To do so, the current evidence in literature was extensively analyzed and the appropriate implications of this review were integrated into the decision-making process after in-depth discussions in 11 consecutive expert meetings.

Diagnostic prerequisites for reproducible treatment recommendations were defined: Conventional X-rays with

consecutive follow-up images (standing position whenever possible), magnetic resonance imaging (MRI), and computed tomography (CT) scan. OF classification allows for upgrading of fracture severity during the course of radiographic follow-up. The actual classification type is decisive for the score.

## Results

### *General Principles for the Application of Recommendations Presented*

The primary goal of any therapeutic regimen shall be the fast mobilization of the patient. At the same time the best pain treatment option available shall be provided.

The OF classification offers a comprehensive score, which shall be applied for every individual fracture as a first step of assessment. A score of up to 5 points generally directs to a primarily nonsurgical treatment strategy whereas a score of more than 6 points may result in additional treatment options, which are then surgical.

- To fully and reliably use both the classification and the score, it is mandatory that the following diagnostic investigations are being provided:

Conventional X-rays of the region of interest, anteroposterior and lateral; whenever possible these images should be taken with the patient in a standing position

- MRI of the whole thoracolumbar spine including a STIR (short tau inversion recovery) sequence
- CT scan including a sagittal reconstruction of the region of interest

Changes in the initial OF classification and/or OF score can occur whenever fractures are being re-evaluated. We recommend doing the first reevaluation 4 to 7 days after the initial one. Conventional X-rays again shall be taken with the patient in a standing position whenever possible. For choosing the

**Table 1.** Osteoporotic Fracture (OF) Classification–Based Scoring System.<sup>a</sup>

| Parameter                             | Grade   | Points              |
|---------------------------------------|---|---------------------|
| Fracture classification type (OF 1-5) | I-5   | 2-10                |
| Bone mineral density                  | T-score < -3  | 1                   |
| Ongoing fracture process              | Yes; No   | 1; -1               |
| Pain (under analgesia)                | VAS ≥4; <4  | 1; -1               |
| Neurological deficit                  | Yes   | 2                   |
| Mobilization (under analgesia)        | No; Yes   | 1; -1               |
| Health status                         | ASA >3; dementia; BMI <20 kg/m <sup>2</sup> ; nursing case; anticoagulation | Each -1; Maximum -2 |

Abbreviations: ASA, American Society of Anesthesiologists risk classification; BMI, body mass index; VAS, visual analogue scale for pain.

<sup>a</sup> 0-5 points = nonsurgical; 6 points = nonsurgical or surgical; >6 points = surgical.

appropriate therapeutic option always the latest OF classification and/or OF score shall be relevant.

Clinical follow-up of all patients regardless whether being treated nonsurgically or surgically shall include measures to reduce both intrinsic and extrinsic factors of fall as a means of further fracture prophylaxis. Intrinsic factors could be disturbances in coordination, disturbance of vision, adverse events of drug medication, and so on; extrinsic factors could be carpets in private homes, inappropriate shoes, and so on.

### Principles of Nonsurgical Therapy

Even though there are no international standards yet for the nonsurgical management of osteoporotic vertebral body fractures,<sup>4</sup> generally 4 aspects of treatment are being applied:

1. Initial bedrest
2. Analgesic drug therapy
3. Physiotherapy
4. Orthoses (optional)

**Initial Bedrest.** Initial bedrest shall be administered as briefly as possible. There is evidence that longer bedrest does not show advantages for fracture healing, but exhibits increasing comorbidities due to immobilization.

**Analgesic Drug Therapy.** Nonsteroidal anti-inflammatory drugs (NSAIDs), paracetamol, metamizole, and opioids are efficient to treat fracture pain. WHO recommendations on the pharmacological treatment of persistent pain frequently cannot be followed due to contraindications or nontolerable side effects. Special emphasis shall be put on comorbidities and comedication in these

often elderly patients. Typical side effects of the aforementioned drugs in elderly patients shall be considered.

**Physiotherapy.** Concomitant physiotherapy is mandatory for these patients to counteract increasing muscle atrophy. Remobilizing exercises help strengthen both thoracolumbar extensors and abdominal muscles thus resulting in stabilization of the trunk. This will help to actively erect the spine. Medical training therapy shall support these efforts. In addition, spine educational programs shall be provided as accompanying measures to teach self-mobilization techniques.

In patients with increased muscle tone due to pain, local physical therapy can be applied (hot/cold treatment, interferential current [IFC] therapy, transcutaneous electrical nerve stimulation [TENS]). This may help detone muscles and promote resorption of local hematomas as long as contraindications are being considered.

Physiotherapeutic measures and medical training therapy shall be maintained after discharge from the acute hospital setting by initiating an inpatient or outpatient rehabilitation program.

**Orthoses (Optional).** The general principle of orthoses is based on re-erection of the trunk according to the 3-point principle. In addition, orthoses help reduce torsional movements, which will support fracture healing without restricting the general mobility of the patient.

For the treatment of L4 and L5 fractures lumbosacral orthoses are sufficient. They should have a reinforced back either custom made from thermoplastic material or ready made with hook-and-loop fasteners on the front side.

Mid-thoracic to mid-lumbar fractures can be treated with thoracolumbar orthoses. In individual cases, a custom-made trunk corset may be applied, for example, in a 2-shell technique.

Pfeifer et al<sup>5</sup> had performed a prospective randomized study on patients with osteoporotic thoracolumbar fractures using a spinal orthosis and reported increased trunk muscle strength, improvement of posture and body height in patients treated.

### Principles of Surgical Therapy

As a general remark, we want to emphasize that the surgical treatment of osteoporotic vertebral body fractures requires spine specialists familiar to the specific requirements of these injuries being able to address any specific complication that may occur.

When evaluating the most feasible surgical technique for any given fracture, it is more important to gain biomechanical stability rather than preserve motion segments. It is mandatory to reconstruct the physiological loading capacity of the spine. If possible, reconstruction of the individual age-specific sagittal and coronal profile shall be pursued. If the patient was in a compensated unbalanced state at the time of fracture, reconstruction of the individual prefracture sagittal profile may be sufficient; thus, not in all cases will it be necessary to bring back the spine to a full anatomical reconstruction.

Because of expected comorbidities in this age group minimally invasive procedures shall be preferred. Screw placement techniques must take into account the situation of inherently compromised bone quality. We thus recommend either cement augmentation techniques or the use of special screw design accounting for limited bony purchase.

Principles of nonsurgical therapy as outlined above shall also apply for the postoperative management of surgical patients.

Throughout the entire article, the term “long-segment posterior instrumentation” shall refer to a minimum instrumentation of 2 segments above and below the fractured index vertebra.

## Recommendations for Individual OF Fracture Classification Types

### OF 1 No deformation (vertebral body edema in MRI STIR)

- Mode of therapy recommended: Nonsurgical management
- Type of nonsurgical management that shall be applied: Analgesic drug therapy, trunk-stabilizing physiotherapy, medical training therapy, local physical therapy
- If indication for surgery present: Cement augmentation of the fractured vertebral body

### OF 2 Deformation without or with only minor involvement of the posterior wall (<1/5)

- Mode of therapy recommended: Nonsurgical management
- Type of nonsurgical management that shall be applied: Analgesic drug therapy, trunk-stabilizing physiotherapy, medical training therapy, local physical therapy, in select cases: orthosis if tolerated by patient
- If indication for surgery present: Cement augmentation of the fractured vertebral body

### OF 3 Deformation with distinct involvement of the posterior wall (>1/5)

- Mode of therapy recommended: Surgical management
- Type of surgical management that shall be applied: Posterior instrumentation with an option of cement augmentation of the fractured vertebral body (Figure 1). Caveat: iatrogenic narrowing of spinal canal. Mobile patients without ongoing fracture process may be treated with stand-alone cement augmentation of the fractured vertebral body
- If surgical management unfeasible: Analgesic drug therapy, trunk-stabilizing physiotherapy, medical training therapy, local physical therapy, optional: orthosis if tolerated by patient

### OF 4 Loss of vertebral frame structure, vertebral body collapse, pincer type fracture

- Mode of therapy recommended: Surgical management
- Type of surgical management that shall be applied:

- In cases with loss of vertebral frame structure: Posterior instrumentation with cement augmentation of the fractured vertebral body (caveat: iatrogenic narrowing of spinal canal), or long-segment posterior instrumentation
  - In cases with vertebral body collapse: Long-segment posterior instrumentation. In cases with reducible vertebral body collapse: Posterior instrumentation with cement augmentation of the fractured vertebral body (caveat: iatrogenic narrowing of spinal canal) or posterior instrumentation with additional anterior reconstruction
  - In cases with pincer type fracture: Posterior instrumentation with an option for anterior reconstruction
- If surgical management unfeasible: Analgesic drug therapy, trunk-stabilizing physiotherapy, medical training therapy, local physical therapy, optional: orthosis if tolerated by patient

### OF 5 Injuries with distraction or rotation

- Mode of therapy recommended: Surgical management
- Type of surgical management that shall be applied: Long-segment posterior instrumentation. Short-segment posterior instrumentation only feasible in tension-band principle situations or in combination with anterior reconstruction
- In isolated cases where surgical management is unfeasible: Analgesic drug therapy, trunk-stabilizing physiotherapy, medical training therapy, local physical therapy, orthosis in mobilized patients if tolerated

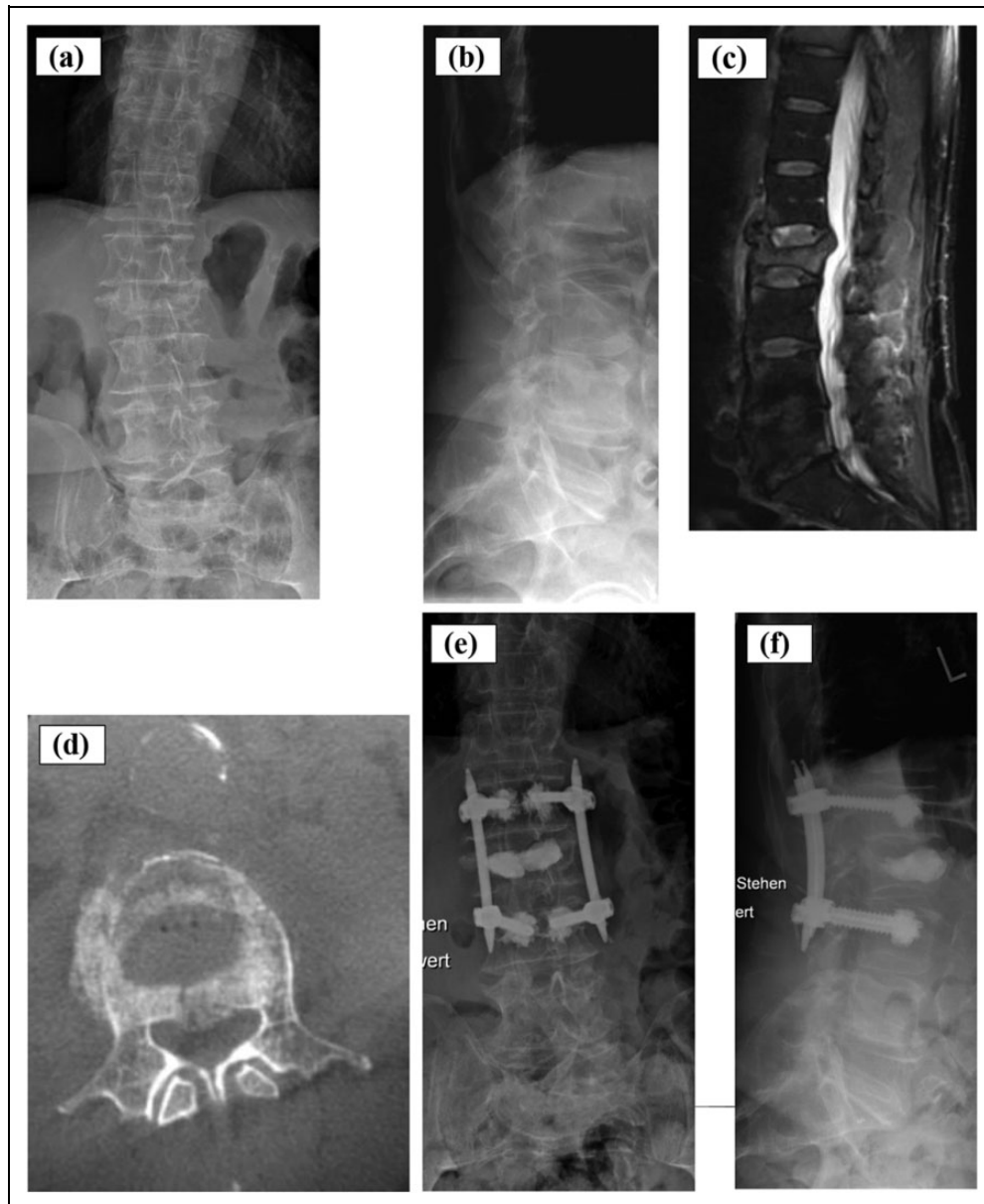
## Particular Situations

The gold standard for instrumented stabilization is instrumentation without fusion. Constellations where fusion may be necessary are limited (eg, in a situation with additional extensive posterior decompression).

In injuries with a neurologic deficit present, we recommend performing posterior decompression in addition to instrumented stabilization/fusion.

In situations with multiple synchronous vertebral body fractures, the following algorithm shall be followed: If there are any additional fractures 1 or 2 levels adjacent to the intended instrumentation/augmentation these fractures shall be integrated into the stabilization procedure disregarding their fracture classification type. If intended stabilization of multiple fractures would leave a single intact vertebral body in between, this vertebral body shall be integrated into the overall stabilizing procedure. In select cases, it may be feasible to cement augment the intact vertebral body adjacent to long-segment instrumentations.

Metachronous fractures represent situations in which the choice of treatment is chosen in accordance with the particular OF classification type. However, preexisting instrumentations/augmentations can necessitate variant strategies.



**Figure 1.** A 77-year-old male patient with an osteoporotic fracture of L2. Osteoporotic fracture (OF) classification type 3. Patient has consistent pain (visual analogue scale [VAS] 10) under analgesic treatment and is unable to be mobilized for more than 2 weeks. On OF scoring system he has a score of 9 points. L2 fracture in conventional X-rays in the anteroposterior (a) and lateral (b) views. Fresh L2 fracture in the magnetic resonance imaging (MRI; T2-sequence) with high signal intensity. Subsequent spinal canal stenosis (c). Endplate depression of L2 with posterior wall involvement in computed tomography (CT) scan (d). Postoperative conventional X-rays in the anteroposterior (e) and lateral (f) views in a standing position after short segment percutaneous instrumentation L1/L3 with cement-augmented pedicle screws and additional cement augmentation of the index vertebral body L2.

Osteoporotic fractures in ankylosing spondylitis shall be treated with posterior long-segment stabilization.

## Discussion

Unlike trauma situations in young patients, where essential principles of treatment have been established, OF treatment still lacks clear treatment strategies. Fracture classifications available for the young-patient trauma constellation cannot

readily be transferred to the needs of elderly people with compromised bone quality.

Because of this, it was the intention of the Spine Section of the German Society for Orthopaedics and Trauma to first develop a score that accounts for the special morphological and radiological findings in aging-spine trauma situations. The next step was then the publication of a score helping to evaluate individual patients' needs concerning nonsurgical or surgical treatment along with the recommendations presented here. Thus,

the treating physician has a tool on hands to guide him through the vast variety of trauma constellations in elderly patients.

In general, a majority of osteoporotic fractures can be successfully treated without surgery. As stated below, this is especially true for all OF fracture classification types 1 and 2 as well as for all fracture situations scoring lower than 6 in the OF scoring system. Only if there are specific findings triggering into surgery like neurological impairment, persistently high pain level under anaesthesia and impossibility of mobilization, ongoing fracture process at follow-up, high-grade fracture instability with OF fracture classification types 3 to 5, will surgical strategies come into account. This is especially true with high scores in the OF scoring system.

For OF 1 and 2 fracture classification types the recommended mode of treatment is nonsurgical management. We have tried to give a comprehensive roundup of conservative treatment modalities available including physiotherapeutic treatment strategies and physical therapy options.

For OF 3 to 5 fracture classification types the recommended mode of treatment is surgical management. Especially for OF types 3 and 4, selecting the most feasible type of surgical therapy can be very challenging. Stand-alone cement augmentation techniques are usually not sufficient for these types of fracture. There is, however, a clinical trend for these techniques to be performed despite the above finding. Reasons for this could be insufficient diagnostic evaluation of individual fracture types, incorrect assessment of fracture instability, or a limited surgical portfolio.

Whenever surgical strategies are being considered, possible complications of these treatment methods have to be taken into account as their occurrence will have an impact on this typically frail and vulnerable population. Especially, intraoperative complications of minimally invasive surgical (MIS) cement augmentation techniques (ie, screw augmentation, vertebral body augmentation) should be considered:

- Injuries of neurological structures
- Paravertebral/epidural cement leakage
- Cement embolization into draining segmental veins
- Perforation of vertebral body with injuries of anterior vessels/organs
- Hematoma
- Pneumothorax
- Contrast fluid incompatibilities

As a limitation of these recommendations we need to acknowledge the fact that an OF score of 6 indicates

intermediate clinical situations allowing for both nonsurgical and surgical management. In these cases, individualised treatment decisions may still be necessary.

## Conclusion

The therapeutic recommendations presented here provide a reliable and reproducible basis to decide for treatment choices available. However, intermediate clinical situations remain with a score of 6 points allowing for both nonsurgical and surgical options. Because of that, individualized treatment decisions may still be necessary. In the next step, the recommendations presented will be further evaluated in a multicenter controlled clinical trial.

## Declaration of Conflicting Interests

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