

# Classification of Osteoporotic Thoracolumbar Spine Fractures: Recommendations of the Spine Section of the German Society for Orthopaedics and Trauma (DGOU)

Global Spine Journal  
2018, Vol. 8(2S) 46S-49S  
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DOI: 10.1177/2192568217717972  
journals.sagepub.com/home/gsj



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## Abstract

**Study Design:** Expert opinion.

**Objectives:** Osteoporotic vertebral fractures are of increasing medical importance. For an adequate treatment strategy, an easy and reliable classification is needed.

**Methods:** The working group “Osteoporotic Fractures” of the Spine Section of the German Society for Orthopaedics and Trauma (DGOU) has developed a classification system (OF classification) for osteoporotic thoracolumbar fractures. The consensus decision followed an established pathway including review of the current literature.

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**Results:** The OF classification consists of 5 groups: OF 1, no vertebral deformation (vertebral edema); OF 2, deformation with no or minor (<1/5) involvement of the posterior wall; OF 3, deformation with distinct involvement (>1/5) of the posterior wall; OF 4, loss of integrity of the vertebral frame or vertebral body collapse or pincer-type fracture; OF 5, injuries with distraction or rotation. The interobserver reliability was substantial ( $\kappa = .63$ ).

**Conclusions:** The proposed OF classification is easy to use and provides superior clinical differentiation of the typical osteoporotic fracture morphologies.

### Keywords

osteoporotic vertebral fractures, thoracolumbar, classification, reliability

## Introduction

Osteoporotic fractures of the spine are an increasing and important health care issue because these fractures can result in significant morbidity and potential mortality. The incidence of osteoporosis in the elderly population continues to rise constantly.<sup>1</sup> Management of osteoporotic vertebral fractures mostly affects elderly patients and is complicated because of existing comorbidities, impeded functional reserves, cognitive dysfunction, and often multipharmacy.<sup>1</sup> Osteoporosis can either be the cause of thoracolumbar fractures (nontraumatic fracture) or act as a contributing factor in traumatic fractures.

Commonly used trauma classifications (AOSpine, Denis, TLICS, etc) were initially not developed for osteoporotic fractures. On the other hand, classifications for osteoporotic insufficiency fractures are not common in trauma surgery. This might be the reason that until now no classification of osteoporotic vertebral fractures has gained international acceptance.

In this article, we will shortly review existing osteoporotic fracture classifications and propose a new classification based on the work 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 2010. The members of the working group were recruited from all over Germany and Austria and from hospitals of all levels of care.

## Review of Existing Classifications

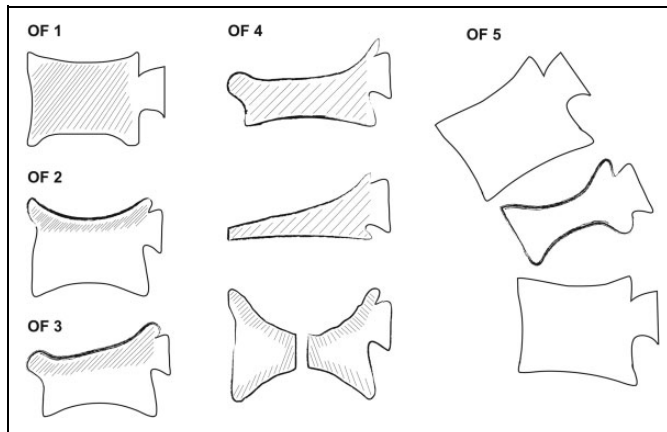
Ever since the early 1960s, numerous authors attempted to classify osteoporotic fractures and proposed classifications based on conventional radiographs, computed tomography (CT), or magnetic resonance imaging (MRI).<sup>2-8</sup> However, only the following classifications gained international acceptance to some extent.

In 1993, Genant et al<sup>5</sup> proposed a semiquantitative assessment of osteoporotic vertebral fractures. Their evaluation was based on the vertebral shape (wedge, concave, or crush) and on the decrease of the anterior, posterior, and/or middle vertebral height. They graded the fractures as follows: grade 0 (normal), with no loss of height; grade 1 (minimal fracture), with 20% to 25% loss of height; grade 2 (moderate fracture), with 25% to 40% loss of height; grade 3 (severe fracture), with loss of height greater than 40%. The interobserver reliability showed a  $\kappa$  of .74, suggesting substantial reliability. The Genant classification

has proven to be a useful diagnostic and prognostic tool. It is widely used for epidemiological studies. However, it has not gained substantial importance in the surgical field. Unstable distraction injuries or fractures with displacement are not addressed at all. Furthermore, estimating loss of height in percentage is very subjective, especially in degenerative spines.

In 1995, Sugita et al<sup>6</sup> classified osteoporotic fractures into 5 types based on the initial lateral radiographs: (1) the swelled-front type, in which 50% of the anterior wall of the vertebral body was swollen; (2) the bow type, in which the anterior wall was pinched in and endplate was falling in, resembling the bow of a ship; (3) the projecting type, in which 50% of the anterior wall of the vertebral body was projecting and which appeared as a small bulge without a fracture line; (4) the concave type, in which the endplate was falling in and the anterior wall was intact; and (5) the dented type, in which the center of the anterior wall of the vertebral body was dented and fracture line was shown in the vertebral body. The intention was to create a prognostic classification system. Their findings based on 135 fractures in 73 patients. They observed that the swelled-front-type, bow-shaped-type, and projecting-type fractures had a poor prognosis with higher incidence of vacuum clefts and late collapse. In contrast, the concave-type and dented-type fractures had a good prognosis and almost achieved fusion. This work is of great importance because the authors could demonstrate that some types of osteoporotic fracture are at high risk for further collapsing. A further risk factor for fair outcome was a fracture at the thoracolumbar junction with vacuum clefts. Patients with this type of fractures who underwent conservative treatment needed 1.5 years for bony healing on average. In summary, Sugita and colleagues clearly refuted the story that osteoporotic vertebral compression fractures are always benign.

Kanchiku et al<sup>7</sup> were the first to compare the diagnostic success rates for osteoporotic fractures using MRI and plain radiographs. They included 34 patients with a total of 316 fractures. Not surprisingly, more fractures could be detected with MRI (98% vs 78%). According to the area of regional intensity changes seen on T1-weighted midsagittal images, the authors classified the fractures into 6 types: total, anterior, posterior, superior, inferior, and central. No intraspinal protrusion in the inferior and superior types was seen, but there was a high frequency of intraspinal protrusion in the total and posterior types, which the authors believe to be more unstable. The



**Figure 1.** Schematic representation of the 5 OF subtypes (OF 1-5).

authors stated that the limitation of their MRI classification is to determine the operative indication of the vertebral fracture.

## Methods

In 2010, the working group “Osteoporotic Fractures” of the Spine Section of the German Society for Orthopaedics and Trauma (DGO) was founded. The intention of the group was to develop an easy to apply classification for daily practice. The classification should consider typical morphological patterns and the biomechanical stability of the fractures. The classification would further serve as a foundation for treatment recommendations.

The group followed an established methodological pathway.<sup>9</sup> In the first step, the group examined 707 osteoporotic fractures in a prospective multicenter trial.<sup>10</sup> Typical fracture patterns could be identified and were discussed. Since about 50% of the patients were uncertain if they have had any trauma, the group decided to develop one classification for both traumatic and nontraumatic (insufficiency) fractures. The classification was based on all available radiological examinations (X-rays, CT, MRI). After 14 consecutive group meetings with in-depth discussions, a morphological classification with 5 subgroups was proposed.<sup>11</sup>

## Results

The osteoporotic fracture classification (OF classification) is provided below (Figure 1).

*OF 1:* No vertebral deformation (vertebral body edema in MRI-STIR only). This type is rare. The stable injury is clearly visible on MRI-STIR sequence only. X-rays and CT scan do not show vertebral deformation.

*OF 2:* Deformation with no or only minor involvement of the posterior wall (<1/5). This type of fracture affects one endplate only (impression fracture). The posterior wall can be involved, but only minor. OF 2 are stable injuries.

*OF 3:* Deformation with distinct involvement of the posterior wall (>1/5). This type of fracture affects one endplate only, but shows distinct involvement of the anterior and

posterior wall (incomplete burst fracture). The fracture can be unstable and may collapse further over time.

*OF 4:* Loss of integrity of the vertebral frame structure, or vertebral body collapse, or pincer-type fracture. This subgroup consists of 3 fracture types. In case of a loss of integrity of the vertebral frame structure both endplates and the posterior wall are involved (complete burst fracture). A vertebral body collapse is typically seen as a final consequence of a failed conservative treatment and can impose as a plain vertebral body. Pincer-type fractures involve both endplates and may lead to severe deformity of the vertebral body. OF 4 are unstable fractures and intravertebral vacuum clefts are often visible.

*OF 5:* Injuries with distraction or rotation. This group is rare but shows substantial instability. The injury includes not only the anterior column but also the posterior bony and ligamentous complex. OF 5 injuries can be caused either by a trauma directly or by ongoing sintering and collapsing of an OF 4.

The interobserver reliability of the classification was calculated after evaluation of 146 consecutive collected fractures (DICOM images) by 6 raters and was found to be substantial with a  $\kappa$  of .63.<sup>12</sup> Ninety-five percent of the fractures belonged either to OF 2, OF 3, or OF 4 types.

## Discussion

The proposed OF classification is an attempt to group the most common osteoporotic fracture types from a clinical point of view. The developing clinicians agreed that the fracture types 4 and 5 are clear indications for surgical treatment. Type OF 3 may be treated surgically or conservative. OF 1 and OF 2 are indications for conservative treatment. Together with the classification the working group developed a score for therapeutic decision making and proposed guidelines for treatment. The latter are published in the same issue of this journal. However, it remains unclear whether this classification will be of any prognostic value. So far it represents only an expert opinion, and future studies will show whether this classification has any advantages in comparison to the existing ones.

## Conclusion

The OF classification consists of 5 subgroups and shows substantial interobserver reliability. In comparison to previously published classifications, the OF classification is easy to use and provides a superior differentiation of the typical osteoporotic fracture morphologies.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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