

Towards a unified approach: Standardising radiological diagnosis and grading of vertebral compression fractures

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ABSTRACT

Vertebral fragility fractures are a common cause of morbidity in osteoporotic patients. Despite their association with a high risk of future fractures, significant morbidity and increased mortality after fracture, they often do not receive adequate attention from doctors, researchers or patients. Contributing factors include the improper application of current fracture classification systems and the overwhelming volume of imaging studies. The issue is further compounded by the absence of a universal consensus on the identification and grading of vertebral compression fractures. Regular updates to the definitions of osteoporotic vertebral fractures are necessary as more sensitive and specific diagnostic methods emerge. Establishing a practical consensus is crucial for ensuring standardised reporting, equitable clinical trial assessments, accurate reimbursement and appropriate management.

Keywords: compression fracture, consensus, osteoporosis, radiology, spine

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INTRODUCTION

Vertebral compression fractures (VCFs) are frequently missed on frontal and lateral chest radiographs.¹ Even with abdominal computed tomography, where sagittal imaging is readily available, up to 84% of grades 2–3 compression fractures can be unreported.² In patients with acute hip fractures, vertebral fractures were found to be unreported in 54% of cases when the spine was evaluated.³ Clinically, osteoporotic vertebral fractures can be challenging to detect, as symptoms are often mild and attributed to nonspecific muscoligamentous pain. When vertebral fractures are apparent on imaging, there is no clear consensus on how to classify them. The use of various diagnostic and grading systems can make detection and assessment more difficult, although such recognition

is increasingly important. Prevalent or incident fractures are often key endpoints in clinical trials for osteoporosis, and variability in fracture detection can significantly impact the outcomes of these trials.

The guidelines from the International Society for Clinical Densitometry (ISCD), International Osteoporosis Foundation (IOF), American College of Radiology, UK and the European guidance lack a clear definition of VCFs. ISCD recommends using the Genant method, while the IOF website lists various references without providing a consensus on VCF detection.⁴ The European guidance only addresses vertebral fracture assessment without specifying how to identify VCFs.⁵ The American College of Radiology focuses solely on the management of VCFs. UK guidelines reference morphometric, Genant and algorithm-based quality methods for visually evaluating and recognising endplate fractures but do not offer definitive guidelines. Additionally, the Osteoporosis and Metabolism Subcommittee of the European Society of Musculoskeletal Radiology recently published a review providing a comprehensive overview of VCFs.⁶ While the article did provide some guidance on how to diagnose these fractures, even going as far as proposing an algorithm on how to do so, it lacked a clear consensus statement, due to the complexity of the problem. It is important to recognise that the Genant method was developed for classifying asymptomatic VCF using radiographs and is not intended for classifying post-traumatic fractures. Traumatic vertebral fractures should instead be classified using alternative systems, such as the AO Spine Thoracolumbar Injury Classification and Severity Score. This system classifies osteoporotic VCFs based on the deformation of 1 or both endplates, with or without posterior wall involvement, and divides these fractures into 5 subgroups.⁷ However, the definition of endplate deformation remains unclear, and the 5 subgroups are difficult to apply in practice.

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Reaching a universal consensus on the identification and grading of VCFs is essential for various aspects of healthcare. Without it, patients with similar imaging findings may receive inconsistent diagnoses and varying treatment plans, leading to undertreatment or even no treatment for some individuals. This increases the risk of existing fractures worsening or preventable new fractures occurring. The absence of a consensus also hampers the proper assessment of follow-up imaging and evaluation of treatment response. Furthermore, it complicates the ability of policymakers to establish standardised guidelines for clinical practice when diagnostic agreement is lacking. Reimbursement policies also become more challenging, potentially leading to inequitable costs for patients receiving different therapies despite having similar imaging results. Last, the lack of standardisation can impede research by limiting the ability to compare outcomes from vertebral fracture-based clinical trials, restricting cross-study collaboration and data pooling. Standardising diagnostic methods would improve scientific efforts, enabling more reliable findings and more refined conclusions through easier comparison of different studies.

Genant semiquantitative grading for vertebral fractures

The Genant semiquantitative grading system, introduced in 1993,⁸ is the classic method for grading osteoporotic VCF. This method classifies vertebral bodies into 1 of 4 grades based on the degree of height loss, with increasing height loss over time indicating fracture progression. While widely used, the Genant method has certain limitations. First, although Genant emphasised the importance of distinguishing between cortical and endplate fractures, the semiquantitative method does not provide specific guidance on how to address these fractures. When the Genant method is used in isolation, there is no consensus on how to classify fractures that occur without associated height loss. Genant recommended a combined approach, incorporating both the semiquantitative method and more traditional fracture identification patterns, but a unified system would be more clinically valuable.⁸ Second, the exclusion of grade 0.5 fractures aims to avoid mislabelling short vertebrae as compression fractures, but some of the fractures, particularly those involving cortical or endplate damage may progress over time. Last, trabecular microfractures, which are identified through marrow oedema on magnetic resonance imaging (MRI) and often occur without height loss after low-energy spinal trauma, are not adequately addressed by the semiquantitative method, despite

Genant's recognition of their importance. In addition, the use of area reduction for grading trabecular microfractures had previously been proposed though due to difficulties in calculating percentage of area loss, it was consequently abandoned.

Alternative factors to consider when grading

The grading system proposed by Genant has the potential to overlook certain clinically significant fracture types, leading to under-reporting in clinical trials or insufficient treatment for at-risk patients. This could result in the progression of existing fractures or the occurrence of new fractures, either in the spine or elsewhere. Additionally, factors like patient positioning and angulation of the radiographic beam can affect the estimated vertebral height loss, influencing the fracture grade. Pathologies detected at the edges of radiographs are especially prone to artifact, which may affect the sensitivity of detecting VCF and the accuracy of measuring height loss. Therefore, any standardised system for identifying and grading fractures should be comprehensive enough to ensure proper classification of all fractures.

In a study of over 1500 Chinese women, Wáng et al. demonstrated that participants with mild vertebral fracture (Genant grade 2, subdivided into mild [25–34% height loss] and severe [34–40% height loss]) were at higher risk of developing endplate fractures. Moreover, those with existing endplate fracture had a higher risk of worsening or developing new vertebral fractures compared to those without such fracture.⁹ The Genant method does not consider grade 0.5 deformities as true fractures unless accompanied by a cortical or endplate fracture. However, Wáng's study also showed that vertebrae with endplate and cortical fractures at baseline were at risk of further deterioration.⁹ These findings suggest that deformities classified as Genant grade 0.5, as well as endplate or cortical fractures without height loss, should be considered true fractures—provided that other causes of endplate disruption, such as Schmorl's nodes, are excluded. Additionally, research from the same group in 2020 indicated that vertebral fracture progression differs between males and females. Males with severe vertebral fractures at baseline had a low likelihood (~5%) of developing new spinal fractures over 4 years, while females with severe vertebral fractures had a much higher likelihood (approximately 30%).¹⁰ This highlights the importance of considering gender when evaluating future spinal fracture risk. Kim et al. emphasised the importance of detecting endplate or cortical fracture, regardless of any associated height loss.¹¹ However, identifying these fractures on radiographs

can be challenging, as height loss is typically easier to recognise. On MRI, vertebral body bone marrow oedema can be observed even in the absence of endplate or cortical fractures or loss of vertebral height, especially in the acute stage. In the appropriate clinical setting, this bone marrow oedema is indicative of trabecular microfracture. The long-term significance of bone marrow oedema due to microfractures remains unclear, as no studies have determined whether this type of injury progresses over time. Therefore, fracture identification and grading systems should account for the classification of such trabecular microfractures.

Structured reporting

A structured vertebral fracture report should include key elements such as the vertebral body level, the shape of the vertebral body, endplate and/or cortical fractures, and the severity of vertebral height loss. In addition to specifying the degree of height loss, the report should describe the type of deformity (e.g. wedge, biconcave or crush). Clear, standardised terminology is essential for effective structured reporting. If previous imaging is available, the report should also note any interval changes. Additionally, any deformities not caused by fractures, such as osteoarthritic anterior wedging, Scheuermann's disease, congenital or acquired short vertebrae, Schmorl's nodes and metastatic infiltration, should be clearly identified. Future advancements in artificial intelligence technology may assist radiologists in generating comprehensive reports.

CONCLUSION

The identification and classification of vertebral fractures are important for evaluating patient risk, ensuring proper treatment and monitoring changes over time. These processes are also important in assessing outcomes in osteoporotic clinical trials. However, there is currently no comprehensive consensus on how vertebral fractures should be identified and classified. Existing classification systems do not account for recent advancements in imaging technology. Establishing a practical and unified consensus is essential for standardising clinical diagnoses, research trials, therapeutic management and equitable reimbursement in the future.

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Declaration

The authors declare they have no affiliations or financial involvement with any commercial organisation with a direct financial interest in the subject or materials discussed in the manuscript.

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