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CONSENSUS STATEMENT

Multidisciplinary management of acute osteoporotic vertebral fracture: results of a national Delphi consensus

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Summary

Introduction Acute osteoporotic vertebral fractures (OVFs) are common and underdiagnosed complications of osteoporosis and are associated with pain, disability, functional impairment, and a high risk of secondary fractures. In Spain, the lack of unified protocols for clinical management contributes to the heterogeneity of care in both public and private health care systems. The objective of this study was to establish a national multidisciplinary consensus on the diagnostic, therapeutic, and follow-up criteria for acute OVFs adapted to the context of the Spanish health care system.

Materials and methods This Delphi process was an initiative promoted by the Spanish Spine Society (GEER) and coordinated by a multidisciplinary Scientific Steering Committee made up of eight members. A two-round Delphi methodology coordinated by a multidisciplinary Scientific Steering Committee was performed. Sixty-four experts from seven national scientific societies (orthopedic surgery, radiology, rheumatology, geriatrics, endocrinology, physical medicine and rehabilitation, and bone metabolism) participated. Forty-five statements were formulated and organized into eight thematic sections.

Results A consensus was reached on 44 of the 45 statements. It was agreed that diagnosis should begin with radiography and be complemented with magnetic resonance imaging (MRI) in symptomatic cases. Treatment should begin early with multimodal analgesia, early mobilization, calcium and vitamin D supplementation, and osteoprotective therapy, with a preference for anabolic agents in high-risk patients. The importance of secondary prevention programs, individualized rehabilitation, and comprehensive follow-up was emphasized. No consensus has been reached on the equivalence between vertebroplasty and kyphoplasty.

Conclusion This consensus establishes a standardized and multidisciplinary clinical framework for managing acute OVFs in Spain, aiming to improve clinical outcomes, reduce care variability, and optimize health care resources.

Keywords Delphi · Fracture assessment · Fragility fractures · Osteoporotic fractures · Osteoporotic vertebral fractures · Osteoporosis

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Introduction

Osteoporosis is a systemic skeletal disease characterized by low bone mass and deterioration of bone microarchitecture, leading to increased fracture risk [1]. This disease is prevalent in the elderly population and is among the leading causes of morbidity in this age group [2]. It is estimated that approximately one in two women and one in five men over the age of 50 will experience at least one fragility fracture throughout their lives [3, 4]. Osteoporotic fractures cause pain and disability, significantly decrease patients' quality of life, and increase mortality compared with individuals without fractures [5]. Furthermore, the socioeconomic impact associated with these fractures is considerable [6], as health care costs resulting from fragility-related fractures can exceed those associated with other severe conditions, such as myocardial infarction, stroke, or breast cancer [7].

Among the various locations of fragility fractures, osteoporotic vertebral fractures (OVFs) are the most common worldwide [8]. Most cases are underdiagnosed, as only approximately one-third of OVFs are symptomatic and receive clinical attention [9, 10]. Although the acute clinical manifestations are less evident, these fractures are associated with increased morbidity [11]. Furthermore, they generate high consumption of both direct (e.g., pain management, hospitalizations, and interventional procedures) and indirect (e.g., rehabilitation and long-term care) health care resources [12–14]. This type of fragility fracture in an older individual is sufficient for a diagnosis of osteoporosis and the initiation of treatment, regardless of the DXA findings [15].

The presence of a vertebral fragility fracture is among the strongest predictors of future osteoporotic fractures, reflecting severe underlying bone fragility [16–18]. This multiplier effect makes vertebral fractures a key indicator of residual skeletal vulnerability, as they not only double the risk of future hip fractures but also significantly increase the likelihood of secondary fractures at other skeletal sites [19, 20].

The acute management of OVF in current clinical practice shows considerable variability [21, 22]. Different specialties and centers apply diverse approaches, resulting in inconsistent outcomes, even within the same country or under a unified health administration. In fact, there is a lack of consensus on the optimal treatment and timing of key diagnostic and therapeutic interventions necessary to achieve adequate clinical outcomes. International guidelines also offer conflicting recommendations, particularly regarding the role of MRI in acute diagnostic pathways, the extent of bed rest versus early mobilization, the routine use of spinal orthoses, and the sequencing of antiresorptive and anabolic therapies. These discrepancies contribute to delays and fragmented care, especially in frail elderly patients [22].

In Spain, no unified national guideline exists for acute OVF management. Each specialty adapts general osteoporosis treatment on the basis of its own expertise. Although various Spanish societies have issued guidelines on postmenopausal osteoporosis, none comprehensively address acute OVF or consider the specificities of the Spanish health care system [23–26]. Likewise, international guidelines [27–32] focus on osteoporosis prevention and treatment but do not cover acute-phase OVF management specifically.

The absence of unified national criteria has led to heterogeneous care, potentially causing inequities and delays in key interventions such as early stabilization or secondary prevention. Therefore, a multidisciplinary consensus is needed to define standardized criteria adapted to the Spanish health care system.

Taking all these aspects into consideration, the aim of this Delphi project was to reach a consensus among specialists on the diagnostic, therapeutic, and follow-up criteria for managing acute OVF in Spain.

Materials and methods

Study design

This study was designed using the Delphi methodology. The process was structured in two rounds of voting, supervised by the Scientific Steering Committee, composed of eight specialists in radiodiagnostics, orthopedic surgery, endocrinology, rheumatology, physical and rehabilitation medicine, and orthogeriatrics, who validated the literature search, critically appraised the evidence, and directed the development of the surveys.

A literature review was conducted by the members of the Scientific Steering Committee using the Medline/PubMed, Web of Science, and Scopus databases covering publications from January 2000 to December 2024. Search terms included the following MeSH and free-text combinations: "osteoporotic vertebral fractures", "osteoporotic fractures", "vertebral fractures", and "vertebral compression fractures". Articles published in both English and Spanish were considered. Priority was given to systematic reviews, international guidelines, consensus statements, high-quality observational studies, and randomized trials relevant to diagnostic, therapeutic, and follow-up aspects of OVFs. In addition to the structured search, members of the Scientific Steering Committee proposed key publications based on their clinical expertise, which were reviewed and incorporated when aligned with the objectives of the consensus. The Scientific Steering Committee screened all retrieved and suggested articles for relevance and used this evidence to draft the initial set of statements.

Following the literature review, the Scientific Steering Committee convened for a structured consensus meeting to develop 45 statements. Each statement was crafted based on the existing evidence and the collective clinical expertise of the committee members. The statements were refined iteratively to ensure clarity, clinical relevance, and suitability for evaluation in the Delphi method.

On the basis of this review, the Scientific Steering Committee held a structured meeting to develop and reach a consensus on the statements by voting. The participants in this vote were specialists in Orthopedic Surgery, Radiology, Rheumatology, Endocrinology, Geriatrics, Bone Metabolism and Physical Medicine and Rehabilitation, with extensive experience in the management of OFVs. The panel included experts linked to various national scientific societies, including the Spanish Spine Society (GEER), the Spanish Society of Rehabilitation and Physical Medicine (SERMEF), the Spanish Society of Endocrinology and Nutrition (SEEN), the Spanish Society of Geriatrics and Gerontology (SEGG), the Spanish Society of Bone and Mineral Metabolism Research (SEIOMM), the Spanish Society of Medical Radiology (SERAM), and the Spanish Society of Orthopedic Surgery and Traumatology (SECOT). Eighty-four experts were invited to participate online, but only 64 answered the questionnaire in full. The experts invited to participate in the voting rounds were identified by the boards of the participating national scientific societies. Selection criteria included clinical experience in the management of vertebral fragility fractures and active involvement in osteoporosis-related practice or research. The panel composition included representatives from various specialties: rheumatology (27%), radiology (20%), geriatrics (17%), trauma and orthopedic surgery (13%), rehabilitation (11%), internal medicine/bone metabolism (8%), interventional neuroradiology (3%), and endocrinology (2%). This initiative was promoted by the GEER and coordinated by a multidisciplinary Scientific Steering Committee composed of experts in radiology, orthopedic surgery, endocrinology, rheumatology, geriatrics, rehabilitation, and bone metabolism. The experts were chosen based on their clinical experience, academic qualifications, publication records in osteoporosis and vertebral fractures, and their representation of national scientific societies involved in OVF care. The Delphi methodology was chosen because it enables structured, anonymous, and iterative consensus-building among multidisciplinary experts in situations where evidence is limited or heterogeneous. During the consensus process, open-ended responses from experts were collected to enrich the discussion section of the study. The Scientific Steering Committee maintained the anonymity of the respondents. In accordance with Spanish law and international guidelines, ethical approval was not needed as no patient data were used.

The Delphi process consisted of two rounds of voting. The response period for the first round was 17 days, from January 30 to February 16, 2025. The response period for the second round was 21 days, from March 5 to 26, 2025.

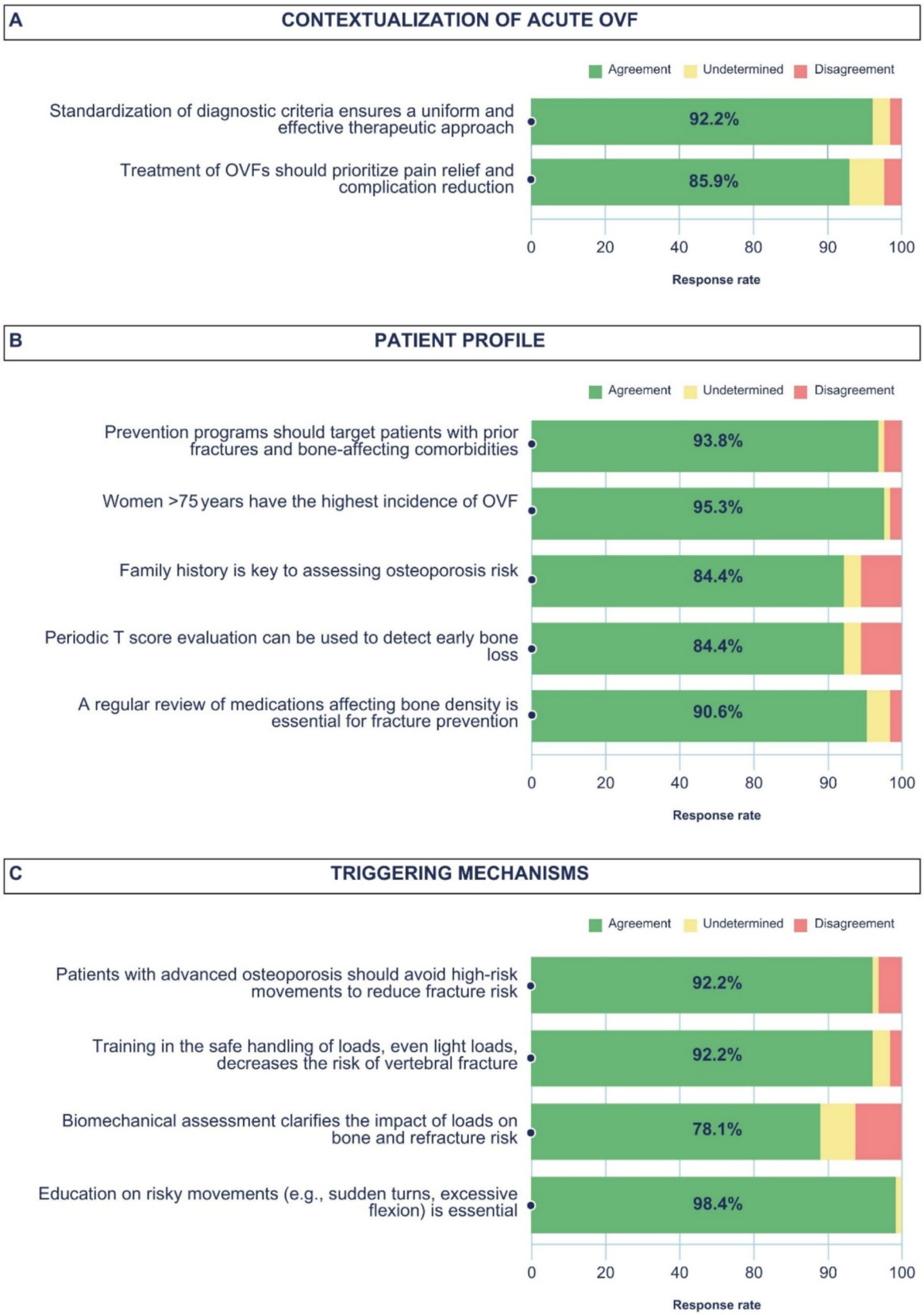
In each round, the Scientific Steering Committee supervised the development of the surveys, reviewed the responses, and prepared summaries to facilitate consensus building. The initial set of 45 statements was developed exclusively by the members of the Scientific Steering Committee, based on the evidence gathered during the literature review and their multidisciplinary clinical expertise. The Scientific Steering Committee did not involve external participants in the drafting of the statements. During each Delphi round, the Scientific Steering Committee reviewed all responses and prepared structured summaries to support consensus interpretation, while an external facilitator managed the technical distribution and collection of the surveys. The questionnaire consisted of 45 statements evaluated using a nine-point Likert scale (1 = "strongly disagree" to 9 = "strongly agree"). The statements were organized into eight knowledge blocks: (1) contextualization of acute OVF; (2) patient profile; (3) triggering mechanisms; (4) diagnosis; (5) treatment; (6) follow-up; (7) rehabilitation and physical medicine; and (8) disease prognosis.

The investigation was executed exclusively through the deployment of surveys, excluding the direct involvement of human participants or the supervision of clinical data. Therefore, approval from an ethics committee was not needed.

Statistical analysis

To analyze the results, frequencies, medians, quartiles, interquartile ranges (IQRs), and percentages of agreement were systematically computed. Consensus was operationally defined by the placement of the median within three predefined intervals: 1–3 (disagreement), 4–6 (neutrality), and 7–9 (agreement). A statement was deemed consensual when the median resided within the agreement interval (7–9) or the disagreement interval (1–3), provided that two additional criteria were concurrently satisfied: (1) the proportion of experts assigning scores outside the respective interval was less than one-third of the total participants, and (2) the IQR was less than or equal to 4.

The dataset was analyzed using LimeSurvey version 6.5.6. (LimeSurvey GmbH, Hamburg, Germany).


A
CONTEXTUALIZATION OF ACUTE OVF
Agreement
Undetermined
Disagreement
Standardization of diagnostic criteria ensures a uniform and effective therapeutic approach
92.2%
Treatment of OVFs should prioritize pain relief and complication reduction
85.9%
0
20
40
80
90
100
Response rate
B
PATIENT PROFILE
Agreement
Undetermined
Disagreement
Prevention programs should target patients with prior fractures and bone-affecting comorbidities
93.8%
Women >75 years have the highest incidence of OVF
95.3%
Family history is key to assessing osteoporosis risk
84.4%
Periodic T score evaluation can be used to detect early bone loss
84.4%
A regular review of medications affecting bone density is essential for fracture prevention
90.6%
0
20
40
80
90
100
Response rate
C
TRIGGERING MECHANISMS
Agreement
Undetermined
Disagreement
Patients with advanced osteoporosis should avoid high-risk movements to reduce fracture risk
92.2%
Training in the safe handling of loads, even light loads, decreases the risk of vertebral fracture
92.2%
Biomechanical assessment clarifies the impact of loads on bone and refracture risk
78.1%
Education on risky movements (e.g., sudden turns, excessive flexion) is essential
98.4%
0
20
40
80
90
100
Response rate

◂**Fig. 1** Level of expert consensus on the contextualization of acute osteoporotic vertebral fracture, patient profile, and fracture triggering mechanisms. OVF, osteoporotic vertebral fracture. The figure provides a synthesized overview of the statements to facilitate visual interpretation, whereas the full and detailed wording of each statement is presented in Supplementary Tables 1, 2, and 3

Results

Among the 84 experts consulted, 64 completed both rounds of the Delphi consensus, resulting in a 76.2% participation rate. All 64 participants who responded to the first round also completed the second, resulting in a 100% round-to-round retention rate. In the first round of 45 statements, 42 reached consensus (93.3%), whereas three did not (6.7%). Then, the process moved on to the second round. The Scientific Steering Committee decided to reformulate three of the statements to improve the clarity of the message. In the second round of three statements, two reached consensus (66.7%), and one did not (33.3%). Finally, in this Delphi consensus of 45 statements, 44 reached a consensus (97.8%), and one did not (2.2%). All the responses to the statements are listed in Supplementary Tables 1–8.

Contextualization of acute OVF

Two statements were evaluated, and a consensus was reached in the first round of voting. The results are shown in Fig. 1A.

The experts considered defining standardized diagnostic criteria for the different types of OVFs to ensure consistent and effective management (92.2% agreement). They also considered that treatment should focus primarily on pain relief and the prevention of complications (85.9% agreement).

Patient profiles

Five statements were evaluated, and a consensus was reached in the first round of voting. The results are shown in Fig. 1B.

Experts agreed that intervention should be prioritized for individuals with a history of fragility fractures or comorbidities that compromise bone quality (93.8% agreement), highlighting women over 75 years of age as a high-risk group (95.3% agreement). They recognized the essential need for systematic identification of a family history of fracture, especially of the hip (84.4% agreement), as well as the periodic implementation of bone mineral density (BMD) evaluation in at-risk populations (84.4% agreement). Monitoring of treatments that negatively affect BMD (such as glucocorticoids, heparins, or hormonal therapies) was identified as a key strategy for fracture prevention (90.6% agreement).

Triggering mechanisms

Four statements were evaluated, with three reaching consensus in the first round. One of the statements was reformulated by the Scientific Steering Committee to improve its understanding. A consensus was reached in the second round. The results are shown in Fig. 1C.

Experts agree on the need to educate patients with advanced osteoporosis about high-risk activities, such as sudden twists or forced trunk flexion, as preventive measures against new fractures (92.2% agreement), as well as on training in safe load handling (92.2% agreement). Biomechanical assessment was considered relevant, although its applicability is recognized as limited in elderly patients (>80 years) because of its complexity (78.1% agreement). An initial statement about the potential risk of physical exercise in people with bone fragility did not achieve consensus. It was reformulated in the second round, where a very high level of agreement was reached (98.4% agreement) by focusing on identifying risky movements (such as sudden turns and excessive trunk flexion) rather than advising against physical exercise in general.

Diagnosis

Seven statements were evaluated, six of which reached consensus in the first round. One of the statements was reformulated by the Scientific Steering Committee to improve its understanding. A consensus was reached in the second round. The results are shown in Fig. 2.

Experts agree that plain radiographs of the thoracic and lumbar spine are the initial test of choice in patients with suspected OVF (92.2% agreement). For acute symptomatic patients, MRI with short tau inversion recovery (STIR)-weighted and/or T2-weighted sequences with fat suppression was considered necessary or essential (87.5% agreement) to differentiate acute/subacute fractures from old fractures. Early assessment of spinal pain in patients without clear trauma was considered critical for early diagnosis (96.9% agreement), as was detailed clinical evaluation using spinal palpation and assessment of vertebral mobility (92.2% agreement). The need for a comprehensive and multidisciplinary diagnostic approach was widely supported (90.6% agreement). The assertion regarding the limited usefulness of laboratory tests in acute OVF was reformulated, and a consensus was reached in the second round (95.3% agreement), where experts considered these tests essential to exclude secondary causes of osteoporosis or conditions that contraindicated specific treatments.

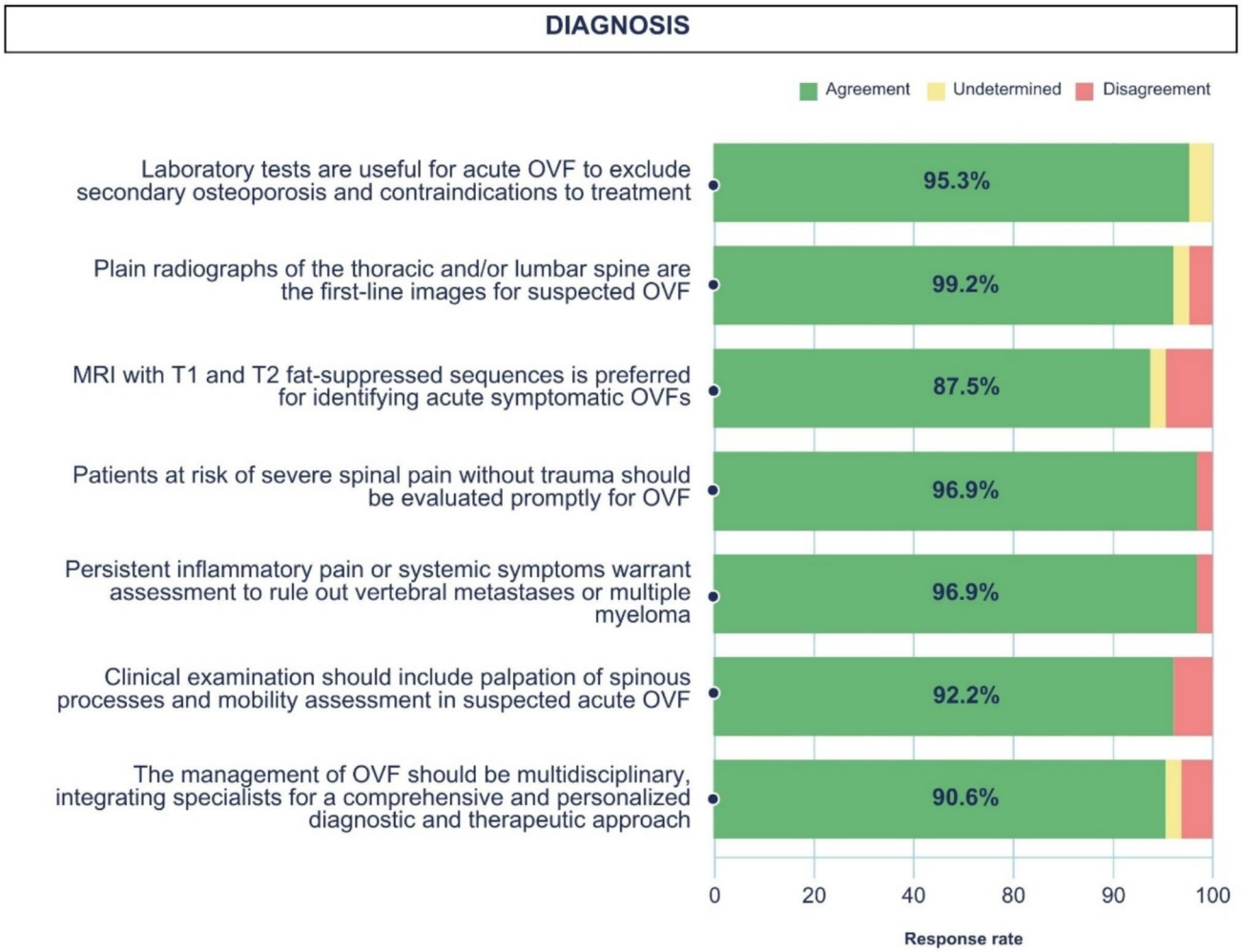


Fig. 2 Level of expert consensus on the diagnosis of acute osteoporotic vertebral fracture. MRI, magnetic resonance imaging; OVF, osteoporotic vertebral fracture. T1, T1-weighted sequence; T2, T2-weighted sequence. The figure provides a synthesized overview of the statements to facilitate visual interpretation, whereas the full and detailed wording of each statement is presented in Supplementary Table 4

Treatment modalities

Thirteen statements were evaluated, 12 of which reached consensus in the first round. One of the statements was reformulated by the Scientific Steering Committee to improve its understanding. Finally, no consensus was reached in the second round. The results are shown in Fig. 3.

Experts agree that nonopioid analgesics should be the first-line treatment for mild to moderate pain (95.3% agreement), whereas the use of opioids should be limited to cases of severe pain and those under close medical supervision (90.6% agreement). Bed rest should be restricted to a maximum of 48–72 h (82.8% agreement), and the use of the visual analog scale (VAS) for pain monitoring was positively evaluated (90.6% agreement). The use of spinal orthoses was considered helpful in the acute phase (87.5% agreement). It was agreed that all patients with acute OVF should start specific treatment for osteoporosis (82.8% agreement), including calcium and vitamin D supplements when there are no contraindications (87.5% agreement). The preferential use of bone-forming agents such as teriparatide in patients with multiple fractures or severe deformities was highlighted (89.1% agreement), and the potential superior benefit of romosozumab in terms of increasing BMD was highlighted, both in treatment-naïve patients and those previously treated with bisphosphonates (89.1% agreement).

Vertebroplasty and kyphoplasty were considered applicable procedures for biopsy in patients with suspected malignancy (87.5% agreement). They also reported that decompressive and instrumented surgery should be reserved for unstable fractures, neurological compromise, or disabling sagittal imbalance (96.9% agreement). Minimally invasive

surgical techniques may be considered in refractory cases after 4–6 weeks of conservative treatment, provided that bone edema is identified on MRI (79.7% agreement). The statement regarding the clinical equivalence between vertebroplasty and kyphoplasty did not achieve consensus even after its reformulation (70.3% agreement).

Follow-up

Five statements were evaluated, and a consensus was reached in the first round of voting. The results are shown in Fig. 4A.

The experts agreed that the primary outcome criterion should be the resolution or improvement of pain, as assessed using a VAS (87.5% agreement). Follow-up X-rays were initially performed between 2 and 6 weeks and then adjusted according to clinical progress (76.6% agreement). They considered the implementation of educational interventions and environmental modifications necessary to prevent secondary fractures (92.2% agreement). Furthermore, follow-up should be individualized, with more intensive care in the acute phase and annual care in the chronic phase (93.8% agreement). A multidisciplinary approach should integrate specialists in rehabilitation, radiology, and other clinical specialties involved in the treatment of OVF (92.2% agreement).

Rehabilitation and physical medicine

Three statements were evaluated, and a consensus was reached in the first round of voting. The results are shown in Fig. 4B.

The experts considered early mobilization necessary to prevent complications such as venous thromboembolism or muscle loss (96.9% agreement). The use of orthoses should be limited to short periods (4–12 weeks) and adapted to the characteristics of the fracture and the patient (95.3% agreement). Furthermore, they recognized the importance of implementing individualized rehabilitation programs tailored to comorbidities and functional limitations (93.8% agreement).

Prognosis

Six statements were evaluated, and a consensus was reached in the first round of voting. The results are shown in Fig. 5.

Experts agreed that the location and degree of vertebral collapse influence chronic pain and long-term functional recovery (90.6% agreement). They identified the presence of comorbidities such as diabetes or sarcopenia as negative prognostic factors (93.8% agreement). Effective initial pain management is crucial for promoting early mobility and preventing complications associated with immobility (95.3% agreement). Given that the risk of refracture within 2 years of the initial event was considered high (92.2% agreement), experts recommend close follow-up. Finally, primary care should play a central role in follow-up, ensuring periodic risk assessment, therapeutic adherence, and clinical monitoring (84.4% agreement). Similarly, providing patients with information about the risk of chronic pain and new fractures is essential (96.9% agreement).

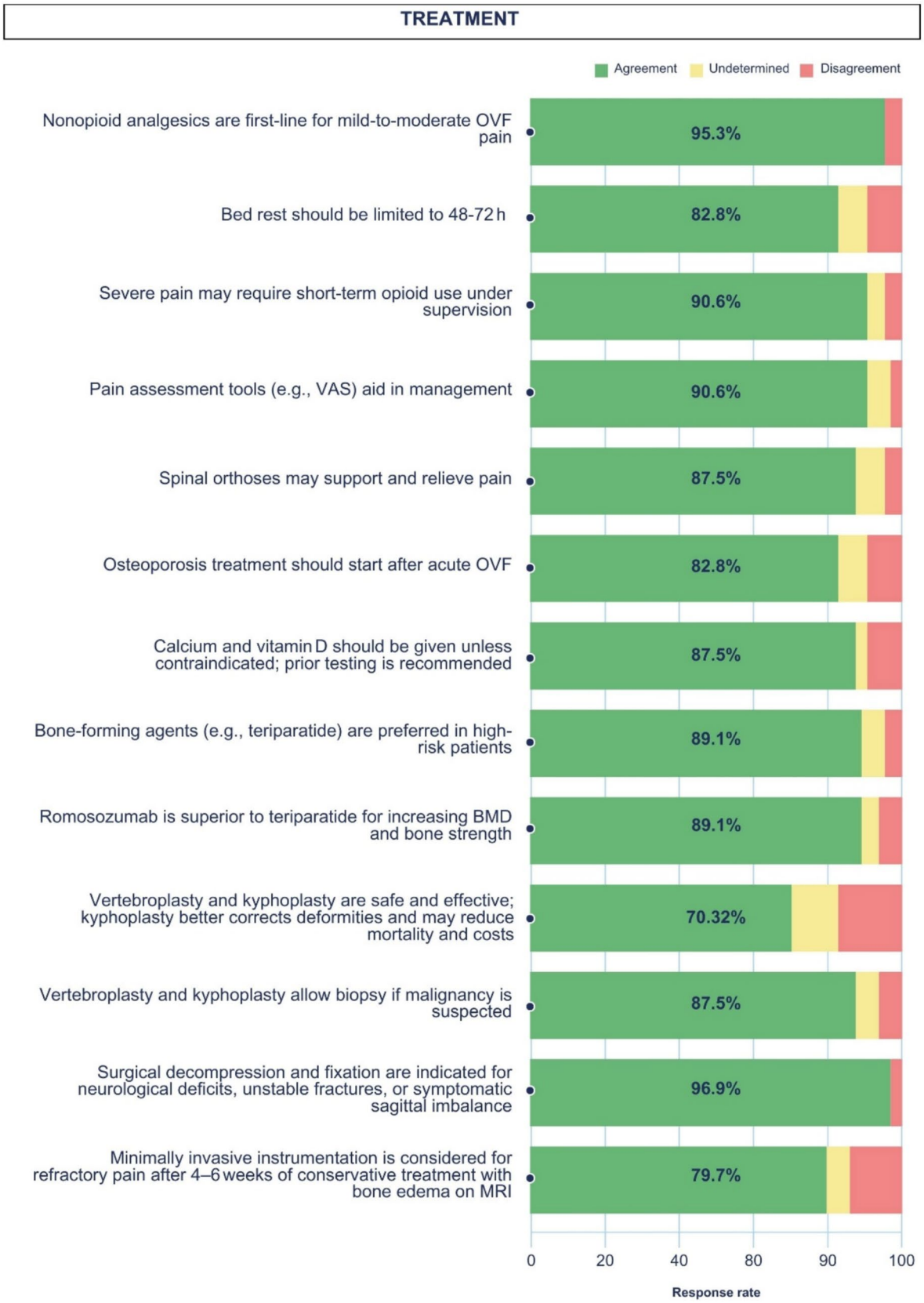
Discussion

The Delphi consensus on the management of OVFs in Spain demonstrated strong agreement among 64 multidisciplinary experts, with 97.8% of the statements achieving consensus after two rounds. The recommendations emphasize the importance of early diagnosis and treatment, including adequate analgesia, functional support, and background treatment for osteoporosis, aligning with international literature on the management of acute OVFs.

Although several statements address general aspects of osteoporosis management, these elements are inherently linked to the comprehensive care of acute osteoporotic vertebral fractures. Because an OVF is itself a diagnostic event of osteoporosis and directly informs decisions regarding analgesia, mobilization, orthotic use, and initiation of anabolic or antiresorptive therapies, the panel considered it essential to include broader osteoporosis-related statements. These general principles provide a clinical foundation for implementing specific recommendations related to OVFs and reflect the realities of multidisciplinary practice in the field.

Some of the statements included in the consensus address general principles of osteoporosis management. These were intentionally incorporated because an acute osteoporotic vertebral fracture represents a sentinel event that confirms the underlying diagnosis of osteoporosis and directly influences therapeutic decision-making. As such, optimal care for OVFs requires integration of broader osteoporosis management elements, including initiation of bone-directed pharmacotherapy, fall-risk evaluation, and long-term secondary prevention strategies. Although clinical practice guidelines for osteoporosis exist in Spain, they do not specifically address the multidisciplinary and time-sensitive aspects of acute OVF management.

A key contribution of this consensus is the call to unify diagnostic criteria. The panel highlights the role of a combined clinical and imaging-based approach, particularly highlighting the central role of MRI. Randomized controlled trials of the highest level (Level I) [33, 34] used MRI with STIR or T2 fat-suppressed sequences to confirm an acute fracture before vertebroplasty but found no significant benefit over placebo, reinforcing MRI as a core diagnostic


TREATMENT
Agreement
Undetermined
Disagreement
Nonopioid analgesics are first-line for mild-to-moderate OVF pain
95.3%
Bed rest should be limited to 48-72 h
82.8%
Severe pain may require short-term opioid use under supervision
90.6%
Pain assessment tools (e.g., VAS) aid in management
90.6%
Spinal orthoses may support and relieve pain
87.5%
Osteoporosis treatment should start after acute OVF
82.8%
Calcium and vitamin D should be given unless contraindicated; prior testing is recommended
87.5%
Bone-forming agents (e.g., teriparatide) are preferred in high-risk patients
89.1%
Romosozumab is superior to teriparatide for increasing BMD and bone strength
89.1%
Vertebroplasty and kyphoplasty are safe and effective; kyphoplasty better corrects deformities and may reduce mortality and costs
70.32%
Vertebroplasty and kyphoplasty allow biopsy if malignancy is suspected
87.5%
Surgical decompression and fixation are indicated for neurological deficits, unstable fractures, or symptomatic sagittal imbalance
96.9%
Minimally invasive instrumentation is considered for refractory pain after 4–6 weeks of conservative treatment with bone edema on MRI
79.7%
0
20
40
80
90
100
Response rate

◂**Fig. 3** Level of expert consensus on the treatment of acute osteoporotic vertebral fracture. BMD, bone mineral density; MRI, magnetic resonance imaging; OVF, osteoporotic vertebral fracture; VAS, visual analog scale. The figure provides a synthesized overview of the statements to facilitate visual interpretation, whereas the full and detailed wording of each statement is presented in Supplementary Table 5

requirement in efficacy trials. Plain radiographs remain first-line, supplemented by semiquantitative criteria [35] and international classification, such as the AO Spine-DGOU [36, 37]. Comparative analyses of morphometric definitions highlight the value of multiple height measurements and strict thresholds (e.g., >20% reduction) to improve diagnostic specificity and reflect bone density differences [38, 39]. However, recent high-quality evidence has shown that individual clinical red flags (age, trauma, and glucocorticoids) have limited diagnostic accuracy. Combining these factors may increase the predictive value, but standardization and further research are needed to refine early clinical screening [40]. In this consensus, plain radiographs are considered the initial imaging modality for all patients with suspected OVFs, whereas MRI is recommended as a second-line study for a defined subgroup, including those with severe or persistent pain, uncertain radiographic findings, or diagnostic ambiguity regarding the acuity of the fracture. MRI is therefore not intended for universal application but for targeted use in cases where clinical or radiological uncertainty remains.

The consensus also underscores the critical importance of early treatment, particularly in the context of pain control, early mobilization, and prevention of new fractures. The panel advocated a multimodal approach, initiating treatment as early as possible. Adequate analgesia (including paracetamol, nonsteroidal anti-inflammatory drugs [NSAIDs], and controlled opioids) was considered essential to avoid complications such as immobility and muscle deconditioning. Although intranasal calcitonin is effective, its side effects limit its widespread use.

Early analgesia and mobilization were deemed key to recovery. Although traditional practice has often recommended 4–6 weeks of conservative management before vertebroplasty or kyphoplasty, this approach lacks strong scientific support and is becoming increasingly challenging. In fact, delaying invasive procedures may unnecessarily prolong disability or allow further deformity progression in some patients. For individuals with severe functional impairment or rapid worsening of deformity, early intervention (even within the first days after fracture) can be justified. The VAPOUR trial revealed improved pain and mobility when vertebroplasty was performed within 3 weeks, with no added benefit if delayed [41]. A recent meta-analysis confirmed greater pain relief and no increase in complications with early procedures [42]. Thus, the indication for vertebral cement augmentation should depend on clinical severity, not fixed timelines (prioritizing pain control, functional recovery, and neurological assessment).

Another important aspect addressed in the consensus is the early initiation of osteoporosis treatment after OFV. Early intervention in osteoporosis is essential to reduce the risk of subsequent fractures, and initiating osteoprotective therapy immediately is recommended, especially in patients at very high risk, for whom starting with osteoanabolic agents may be appropriate according to current clinical guidelines [43]. For these cases, experts also suggest considering osteoanabolic agents such as teriparatide, which have been shown to be effective at restoring bone mass. The panel also supported fracture liaison services (FLSs) for their proven role in secondary fracture prevention. The use of advanced densitometers (e.g., iDXA) was noted as relevant for assessing bone fragility and population screening [44].

Consensus outcomes are conceptually aligned with international guidelines [15, 45], especially concerning early treatment and the use of MRI. To facilitate comparison with existing international recommendations, the main areas of convergence and divergence between this national Delphi consensus and major international guidelines, including those from American Society for Bone and Mineral Research (ASBMR) [46] and National Osteoporosis Foundation (NOF) [47], are summarized in Table S9. Most fractures should be initially managed conservatively, reserving surgery for severe cases. However, comparisons between vertebroplasty and kyphoplasty remain debated. Both relieve pain effectively, but meta-analyses have shown no significant functional differences. Kyphoplasty may offer modest radiological benefits, such as reduced cement leakage and better vertebral height restoration in acute cases [48], but necessitates increased cement use and higher expenses, leading to continued clinical discourse.

The debate over the use of vertebroplasty versus kyphoplasty reflects the lack of conclusive high-quality evidence favoring one technique. A Cochrane review revealed that vertebroplasty offers no meaningful benefit over placebo for pain, disability, or quality of life and may carry risks of serious adverse events [49]. However, a systematic review supported surgical treatment when pain was significant (level I evidence) [50]. Multidisciplinary assessments using the RAND/UCLA methodology have shown that treatment appropriateness varies by MRI findings, symptom duration, and spinal deformity, with balloon kyphoplasty considered more appropriate in complex cases [51]. This underscores the need for individualized decision making over rigid guideline adherence. While both procedures relieve pain, evidence shows no significant differences in mortality or spinal alignment, and most meta-analyses report comparable outcomes. Thus, the choice may depend on clinical context and specialist expertise.

Fig. 4 Level of expert consensus on the follow-up and rehabilitation of patients with acute osteoporotic vertebral fracture. OVF, osteoporotic vertebral fracture; VAS, visual analog scale. The figure provides a synthesized overview of the statements to facilitate visual interpretation, whereas the full and detailed wording of each statement is presented in Supplementary Tables 6 and 7

Several placebo-controlled trials have demonstrated no clinically meaningful benefit of vertebroplasty over sham procedures for pain, function, or quality of life, and the Cochrane review reinforces the lack of evidence supporting routine use of vertebroplasty and highlights potential procedural risks [49]. These negative studies form the core of the ongoing debate and underscore that vertebroplasty should not be applied indiscriminately.

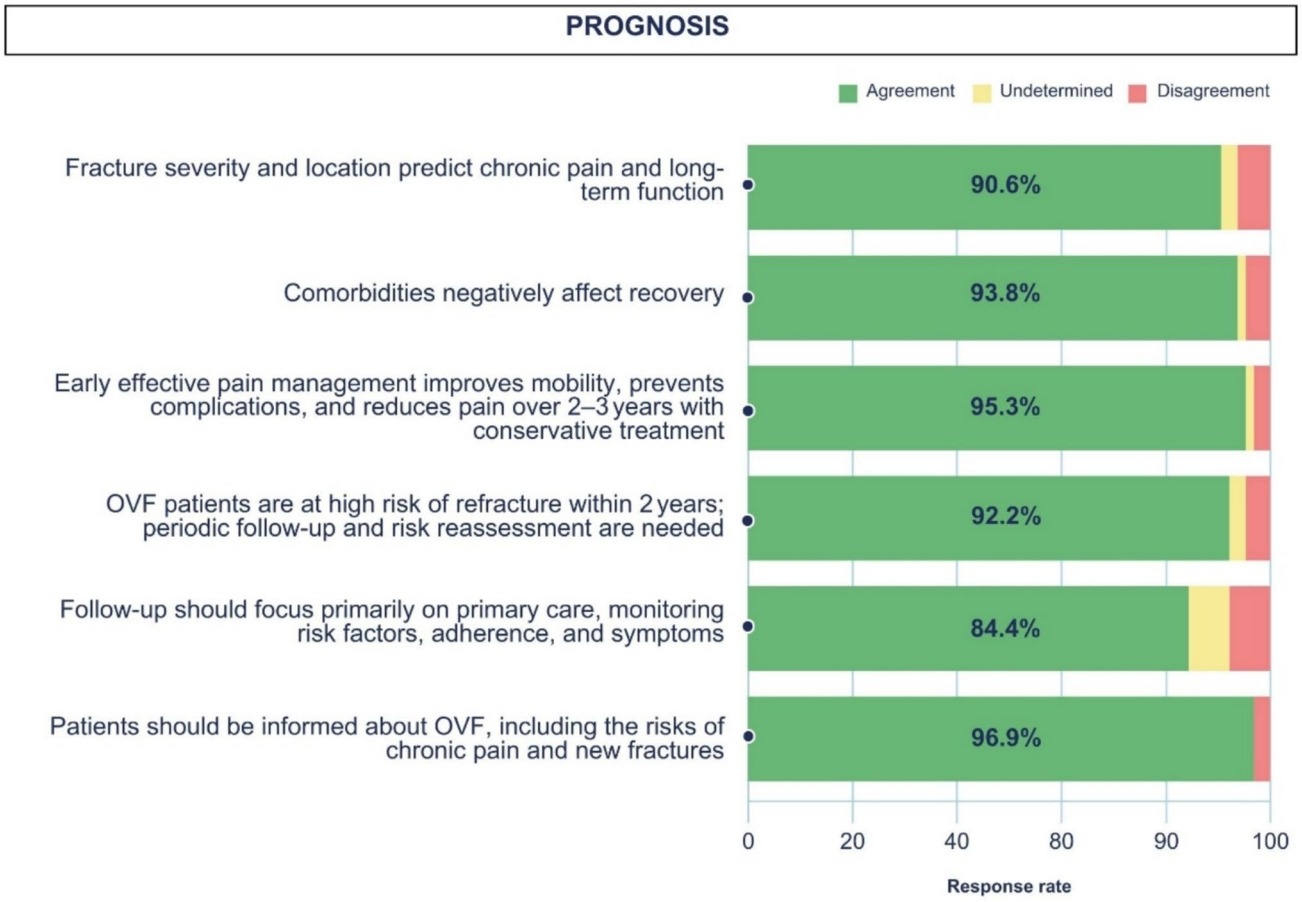


Fig. 5 Level of expert consensus on the prognosis of patients with acute osteoporotic vertebral fracture. OVF, osteoporotic vertebral fracture. The figure provides a synthesized overview of the statements to facilitate visual interpretation, whereas the full and detailed wording of each statement is presented in Supplementary Table 5

Nevertheless, observational studies and randomized trials in highly selected patients with severe, refractory pain have suggested that early vertebroplasty may offer benefit in specific clinical scenarios [41, 42, 50]. Taken together, these findings indicate that vertebral augmentation should be restricted to carefully selected patients after exhausting optimal conservative management.

The use of spinal orthoses in acute OVFs remains debated. Some experts favor rigid braces in the short term, whereas others prefer soft dynamic orthoses for better long-term outcomes. Systematic reviews report limited and inconsistent evidence, with high-quality trials showing no clear advantage of rigid braces over soft braces or no bracing [52]. A recent systematic review (level of evidence Ia) revealed that both rigid and semirigid orthoses improve stability, reduce kyphosis, and enhance function in neurologically intact elderly patients [53]. Randomized trials also support the part-time use of dynamic hyperextension braces to improve functionality, alignment, and respiratory function in osteoporotic women with hyperkyphosis [54].

These findings support the selective, patient-specific use of spinal bracing, especially in cases of postural instability or sagittal imbalance. The consensus recommended personalized application, prioritizing comfort and limiting wear time. Recent trials have shown no significant differences in deformity progression, pain, or quality of life between rigid and soft braces in elderly women with acute fractures [55]. However, orthoses are often poorly tolerated in older adults, and nonadherence may lead to deconditioning. Given the limited evidence, recent reviews advocate for pragmatic, short-duration use tailored to patient needs [56].

The consensus recommendations have relevant clinical implications for improving OVF in Spain. Standardizing diagnosis and treatment can enhance care quality, reduce outcome variability, and optimize health care resources. Experts stress the importance of early identification of fracture etiology by imaging, prompt pain control, and tailored secondary prevention on the basis of risk and comorbidities, including judicious use of bracing and vertebroplasty [57]. In a resource-limited setting, focusing on cost-effective

strategies, such as selective surgery and early osteoporosis treatment, may reduce secondary fractures and hospitalizations, with a positive economic impact.

Collaboration between hospital specialists and primary care is key to ensuring comprehensive, continuous care. National recommendations for elderly patients with vertebral fractures emphasize individualized goals and coordinated follow-up, particularly between geriatrics and primary care [58]. This multidisciplinary approach, endorsed by the consensus, may reduce recurrence and improve functionality. Early osteoporosis treatment, rehabilitation, and fall prevention are crucial, in addition to muscle strengthening. Structured programs such as back schools show moderate benefits for pain and function in patients with chronic low back pain, although their cost-effectiveness remains unclear [59, 60].

Although this consensus offers a useful framework, it has limitations inherent to the Delphi method, which relies on expert opinion and may introduce subjectivity and potential bias [61]. The absence of patient and primary care representation also limits its scope. As the initiative was promoted by GEER, its orientation was inevitably more closely aligned with the perspective of specialists directly involved in the management of OVFs. Physicians who participated in their study were volunteers and were not randomly selected. Therefore, a potential selection bias cannot be excluded, as those who agreed to participate may have been the most motivated or particularly interested in osteoporotic fracture. If clinicians with less expertise or involvement in this field participated, the level of consensus might have been lower. Although this possibility cannot be completely ruled out, it does not substantially affect the validity of the consensus reached. Importantly, a high level of agreement was achieved without implementing strategies to facilitate consensus, despite the large number of participants and the diversity of specialties and health care settings represented [62]. Future studies should assess its impact prospectively, update recommendations regularly, and address areas such as the long-term management of OFVs.

Finally, hospitals are encouraged to develop resource-adapted protocols, ensuring consistent and high-quality care. Rapid reference tools and professional training will be essential for effective implementation.

Conclusions

This consensus provides health care professionals with a practical, agreed-upon framework for addressing acute OVF, with clear recommendations on which tests to order, how to treat, and when to refer. X-ray remains the initial test of choice, whereas MRI should be reserved for selected cases with suspected nonobvious acute fracture or persistent pain. Treatment should begin early with adequate pain control, prevention of new fractures, and follow-up planning from the outset. Furthermore, it highlights the importance of integrating various specialists on the basis of the complexity of the case, including primary care, radiology, rheumatology, geriatrics, rehabilitation, endocrinology, and orthopedic surgery.

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Data Availability The data generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Conflicts of interest Santos Castañeda has received grants or research support from MSD, Pfizer, and UCB Spain. He has also received consulting fees and participated in company-sponsored speaker bureaus for Amgen, Grünenthal Pharma, Eli Lilly, Gedeon-Richter, Janssen, Roche, Sandoz, and UCB Spain, all unrelated to the present manuscript. All the other authors declare that they have no conflicts of interest.

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