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Review

Classifications and treatment management of fragility fracture of the pelvis: A scoping review

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ABSTRACT

Background: Fragility fractures of the pelvis (FFP) present a growing challenge in aging populations. However, standardized classifications and treatment guidelines remain scarce.
Objective: This scoping review examines the application of fracture classifications, treatment strategies, and outcome evaluations for FFP, identifying gaps in the literature, and suggesting directions for future research.
Methods: A systematic search of multiple electronic databases yielded 117 studies discussing FFP names, classifications, treatment approaches, and outcomes. Data extraction focused on study characteristics, classification systems, treatment details, outcomes, and follow-up periods. Residual analysis using the Chi-square test assessed statistical associations and underrepresentation.
Results: The FFP classification was the most common (51.3%), with additional treatment indicators focused on immobility (44.4%) and pain assessment (using the Visual Analog Scale [VAS] or Numeric Rating Scale [NRS], 37.6%), consistent with existing guidelines. In contrast, the sacral insufficient fractures were statistically associated with pain indications but lacked corresponding classification application. Initial management typically involved conservative or observation period. Regarding the management indications and outcomes, surgical interventions were categorized into osteosynthesis and sacroplasty. Outcome evaluations often incorporated mobility and functional status (59.0%), hospitalization length (49.6%), mortality rates (41.0%), and post-treatment living conditions (41.0%). Patient recovery was assessed through VAS scores (59.0%) and Activities of Daily Living Patient-Reported Outcomes (ADL-PROs, 34.2%). However, inconsistencies in standardized outcomes, particularly in sacroplasty studies, hinder comparative analysis.
Conclusion: FFP classifications, along with pain and mobility assessments, were frequently applied as management indicators for FFP. Standardizing treatment indications and establishing consistent outcome measures,

Abbreviations List: 3D-CT, Three-Dimensional Computed Tomography; ADL-PROs, Activities of Daily Living Patient-Reported Outcomes; ASA, American Society of Anaesthesiologists; BBD, Bladder and Bowel Dysfunction; COPD, Chronic Obstructive Pulmonary Disease; DVT, Deep Vein Thrombosis; EQ-5D, EuroQol-5 Dimensions; FFP, Fragility Fracture of the Pelvis; ICU, Intensive Care Unit; IQR, Interquartile Range; MIS, Minimally Invasive Surgery; MCS/PCS, Mental Component Summary/Physical Component Summary; MRI, Magnetic Resonance Imaging; NRS, Numeric Rating Scale; ORIF, Open Reduction and Internal Fixation; OTA, Orthopaedic Trauma Association; PE, Pulmonary Embolism; PMMA, Polymethyl Methacrylate; PROMIS, Patient-Reported Outcomes Measurement Information System; PTH, Parathyroid Hormone; SF-12/36/8, Short Form Health Survey-12/36/8 Items; SIF, Sacral Insufficiency Fracture; SMFA, Short Musculoskeletal Function Assessment; SSI, Surgical Site Infection; VAS, Visual Analog Scale; WHO, World Health Organization.

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including the evidenced gap treatments (sacral insufficient fracture and cement augmentation), could significantly improve comparability across studies.

Introduction

Fragility fractures of the pelvis (FFP) represent a growing concern in the context of an aging global population, with a significant increase in incidence reported over recent years [1–3]. However, there is limited consensus regarding the terminology (keyword registration), patient management indications, and treatment interventions of FFP were utilized [4].

First, FFP has been referred to by various terms, including fracture of the elderly, insufficiency fracture, or osteoporotic fracture (reflecting bone status), and by anatomical locations such as the pelvic, sacral, or pubic rami fractures. Additionally, there are multiple fracture classification systems. The established classifications for pelvic ring lesions in younger adults do not fully capture the clinical and morphological criteria of the FFP [5]. For instance, Young Burgess (Lateral compression type), AO/OTA, Tile, and Denis classifications are primarily used for high-energy trauma. In contrast, FFP resulting from low-energy trauma has been classified using the FFP classification or based on patient-specific factors such as pain scales and activities of daily living (ADL). However, despite increasing literature data and clinical evidence on its origin, natural course, treatment alternatives, and outcomes [4], these indications have not been consistently applied to all patients.

Second, the decision-making process and treatment strategies for FFP also lack uniform dissemination. Typically, FFP management involves conservative treatment, minimally invasive surgery (MIS), or percutaneous procedures. Invasive open surgery is reserved for more severe cases, such as FFP Type III and IV fractures [6]. Treatment indications—whether surgical or non-surgical—frequently rely on FFP classification. Regarding patient history and primary complaints, Chandra et al. reported that sacroplasty yields statistically significant and sustained improvements in VAS pain scores over a 12-month period [7]. The Chinese orthopaedic surgery guideline recently addressed the diagnosis and treatment of FFP, endorsing the FFP classification for its detailed morphological assessment, providing strategic treatment insights [8]. However, the strength of the treatment recommendations remains tentative.

Finally, numerous outcomes and scoring systems exist, yet a consensus on which outcomes should be measured or evaluated - particularly those reflecting adverse effects - remains lacking. For instance, surgeons must evaluate which conservative treatments and fixation techniques for FFP provide sufficient durability for immediate weight-bearing while minimizing operative morbidity and postoperative complications. Previous research has documented outcomes such as mortality rates, pain reduction, shorter hospital stays, and improved mobility and function following surgical fixation of various fracture types. However, these procedures are associated with risks, including infections, implant loosening, pneumonia, and thrombosis [4,6,9–12].

Some systematic reviews have addressed these issues [6–9,11–13]; nevertheless, the classifications, treatment indications, and outcomes for FFP still require a robust evidence base. A 2023 survey by the Orthopaedic Trauma Association revealed international disparities in the diagnostic modalities and management approaches for FFP [14]. Further research is needed to establish evidence-based recommendations for FFP management and achieve international consensus. This scoping review explores the classifications, patient management strategies, and outcomes reported in FFP research to provide a comprehensive overview of the existing literature.

Methods

As outlined in *Appendix 1*, this review follows the protocol described at https://osf.io/6fcug/ and adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) statement [15]. Additionally, we employed the scoping review framework developed by The Joanna Briggs Institute (JBI) [16], which includes the following five-stage approach: identifying research questions, retrieving relevant studies, selecting studies suitable for the research question, charting the data, and summarizing the results from the retrieved literature.

Eligibility criteria and search strategy

This review includes studies involving patients with FFP aged 65 years or older who received either surgical or conservative treatment for pelvic fractures, defined as "pelvic ring fractures caused by low-energy trauma (e.g., minor falls)" [5,8,14]. In this review, a FFP is specifically defined as "a pelvic ring fracture caused by low-energy trauma (e.g., minor falls) in the elderly (aged 65 years or older)"[5]. This review examines decision-making in FFP treatment, including study type, FFP names and classifications, surgical versus non-surgical rates for each classification, treatment methods, outcomes, and complications. Studies from any setting, country, and follow-up duration were eligible. On 26 March 2024, a comprehensive search was conducted across the following databases: MEDLINE, Embase, the Cochrane Central Register of Controlled Trials (CENTRAL), the World Health Organization International Clinical Trials Registry Platform, and ClinicalTrials.gov, as detailed in *Appendix 2*. All published randomized controlled trials, crossover trials, and observational studies with control series were included. However, case reports, case series, conference abstracts, and review articles were excluded.

Inclusion and exclusion criteria

Studies were included if they met all three criteria in the abstract: fragility (low-energy or osteoporotic), pelvic fractures, and treatment modalities. Investigations focusing exclusively on non-pelvic fractures (e.g., femur, spine, or acetabulum) or requiring different treatment approaches were excluded. Studies encompassing conditions beyond FFP (e.g., femoral or spinal fractures, malignancies, or unspecified trauma) were included only if they provided relevant FFP data. Exclusions also applied to studies focusing on other bones (e.g., femur, spine, acetabulum), malignancies, economic analyses, animal or cadaveric models, biomechanical testing, or risk factors without treatment outcomes. Treatments for osteoporosis were excluded unless they specifically promoted bone healing, with the exception of parathyroid hormone agents such as teriparatide.

Study selection, data extraction and synthesis

Study selection was conducted independently by one researcher (K.E.), with subsequent step-by-step confirmation by the other researchers (T.T., Y.N., K.S., T.K., and K.O.). Data extraction followed a standardized approach using data-extraction forms. In cases of disagreement, the matter was referred to N.Y. for resolution. The search results are summarized in a PRISMA flow diagram, and the extracted data are presented as a qualitative synthesis.

Statistical approach for each result table

The total count in the cross tables exceeded 117 due to overlaps in the extracted fracture classifications, guidelines, treatment methods, and outcomes across articles. Percentages were calculated based on the total article count (n = 117) as the denominator. A residual analysis using the Chi-square test was performed for each result table to ensure statistical accuracy and fairness. Standardized residuals greater than 1.96 indicated a strong association, while values less than -1.96 indicated a significant underrepresentation.

Difference between protocol and review

Due to the extensive number of items, a two-step process was implemented. First, data were reviewed by a primary screener (K.E.) and then verified by other members due to the specialized and varied terminology encountered. Second, Chi-square residual analysis was added for each result table (Method 2.4). Exact categorization of studies or case numbers proved impossible in instances where conservative treatment later necessitated surgery; these cases were labeled as NA. Follow-up details were frequently incomplete; thus, only the median and interquartile range (IQR: 25%-75%) of follow-up periods were reported.

Results

Selection of sources of evidence

The study selection process was detailed in Supplemental File *Appendix 3*, while the list of excluded papers was provided in *Appendix 4*. A total of 117 references were included in this scoping review, and a summary of these studies was available in *Appendix 5*. Fracture names and classifications were summarized in *Appendix 6*, along with their respective references. The distribution of studies by country, study design, publication year, and descriptive statistics of patient data across studies is presented in *Appendix 7*. Follow-up periods varied significantly among the studies, with a maximum of 120 months, a minimum of 0.3 months, and a median of 12 months (IQR: 12.0-29.3).

Fracture name and classification

Fragility fracture of the pelvis (75/117, 64.1%), sacral insufficiency fracture (43/117, 36.8%), and pubic rami fracture (11/117, 9.4%) were the frequently identified fracture names of FFPs, as presented in *Table 1A*. The FFP classification was the most commonly applied system for categorizing FFP, referenced in 60/117 studies (51.3%). AO/OTA classification [17] (14/117, 12.0%), Young Burgess classification [18] (11/117, 9.4%), and Tile classification [19] (5/117, 4.3%) were followed but related to no fracture name.

However, sacral insufficiency fractures were rarely classified using the FFP classification, accounting for only 6/43 studies (14.0%). In contrast, Others (13/43, 30.2%) and NA (10/43, 23.3%) were statistically correlated, and Denis classification [20] (9/43, 20.9%) was also prevalent in this group, which highlights that alternative classifications were often used to target posterior factors.

Table 1B illustrates the relationship between treatment indications and treatments. Among additional treatment indications, immobility (52/117, 44.4%), pain (measured via VAS or NRS; 44/117, 37.6%), and ASA classification (17/117, 14.5%) were significant considerations. Notably, sacral insufficiency fractures were statistically associated with pain (VAS, NRS) in 22/43 studies (51.2%).

Treatment type and indication and assistant tool types

Treatments for FFP typically began with an evaluation of the failure of conservative management, with durations ranging from 3 to 111 days (median: 14 days; IQR: 6–21). Conservative management strategies included rest, weight-bearing (partial and full as tolerated), bed rest, pain management, rehabilitation, orthoses, and the use of parathyroid hormone agents to promote bone healing. These were often followed by surgical interventions, as detailed in *Appendix 9A*. As outlined in *Table 2A*, screw fixation was the most commonly performed procedure (72 counts), followed by combination approaches (40 counts), with the FFP classification frequently guiding these treatments. Sacroplasty (34 counts) was another common intervention, although it was statistically underrepresented in the FFP classification. Cement filling or augmentation techniques were increasingly applied to complex sacral fracture types, traditionally managed by more invasive procedures (e.g., spinopelvic fixation for Type IV fractures). This trend reflects a shift toward minimally invasive options, even for cases beyond the standard indications of the FFP classification (*Table 2B*).

The following fracture classifications are also related to ORIF, such as screw fixation, plate osteosynthesis, and combination approaches. AO/OTA classification (23/117, 19.7%) was commonly associated with screw fixation (7/23) and combination approaches or plate osteosynthesis (3/23). Similarly, the Young Burgess classification (18/117, 15.4%) was also applied for screw fixation (6/18) and combination approaches (3/18), while the Tile classification (5/117, 4.3%) was used exclusively without details (4/5).

Table 2C illustrated the relationship between other indications and treatments. Among these indications, immobility (95/117, 81.2%), pain (VAS, NRS; 69/117, 59.0%), and ASA classification (31/117, 26.5%) were significant considerations. Sacroplasty was statistically associated with severe pain (VAS, NRS; 22/39, 56.4%) but indicated underrepresentation in ASA classification-related treatments (0%).

Assistive devices, such as navigation systems and robotic surgery, were commonly employed during procedures (*Appendix 9B*). Fluoroscopy was the most frequently utilized tool (68/117, 58.1%), particularly in sacroplasty (18/68, 26.5%), where significant associations were observed. Advanced technologies, including navigation systems (32/117, 27.4%), 3D-CT (27/117, 23.1%), and robotics (8/117, 6.8%), were also widely implemented, especially for traditional screw fixation procedures (50/77, 64.9%). For sacroplasty, the combination of fluoroscopy and 3D-CT was recommended to improve spatial accuracy during

Table 1
Cross table between fracture name and fracture classification or indications.

Fragility fracture of the pelvis	Sacral insufficiency fracture	Pubic rami fracture	Other 1)	Total
(A) Fracture classification				
FFP	48*	6**	2	4	60
AO/OTA	8	2	1	3	14
Denis	2	9	1	1	13
Young Burgess	5	3	2	1	11
Tile	3		1	1	5
Others 2)	5**	13*	3	9*	30
NA	4	10*	1	1	16
Total	75	43	11	20	149
(B) Other indication					
Immobility	29	14	3	6	52
Pain (VAS, NRS)	14	22*	2	6	44
ASA classification	13	1	2	1	17
Comorbidity	2	1		1	4
Others	1			1	2
Stress test	1		1*	0	2
NA	17	5		9	31
Total	77	43	8	24	152

Total references (n = 117) differed from the total numbers in the reason of duplicates per reference.
Using the Chi-square test, the standardized residuals showed statistical associations (*) and underrepresentation (**).
1) The 'Other' fracture name includes the Appendix 6A.
2) Others include Roy-Camile (n = 2) and Nakatani (n = 2) and other original classifications (each classification; n = 1) detailed in Appendix 6B.

Table 2
Cross the table between treatment types, (A) fracture classification, (B) FFP subtypes (only cement augmentation), and (C) other indications.

	Screw fixation	Sacroplasty	Combination approaches	Plate osteosynthesis	Spinopelvic fixation	Augmentation screw	INFIX	External fixation	NA 1)	Total
(A) Fracture classification										
FFP	40	7**	22	20	11	7	6	6	11	130
AO/OTA	7	1	3	3	1	2	1	1	4	23
Young Burgess	6		3	1	1	1	2	1	3	18
Denis	3	9*	1	1		1			2	17
Tile	1								4*	5
Others	12	7	4	4		1			10	38
NA	3	10*	1	1	1	1	1		3	21
Total	72	34	34	30	14	13	10	8	37	252
(B) FFP subtypes (only Cement augmentation)										
I		0				0				
II		10				11				
III		4				6				
IV		7				9				
Total		21				26				
(C) Other indications										
Immobility	33	13	11	10	7	6	6	4	5	95
Pain (VAS, NRS)	17	22*	8	8	7	3		1	3	69
ASA classification	12	**	4	5	3	3	1	1	2	31
Comorbidity	3		1	1					1	6
Stress test	2				1					3
Other	1	1	1			1			1	5
NA	12	3	10	6	3	2	4	3	14*	57
Total	80	39	35	30	21	15	11	9	26	266

Total references ($n = 117$) differed from the total numbers in the reason of duplicates per reference.
1) NA includes non-surgical treatments and surgical cases without details of the procedures.
Using the Chi-square test, the standardized residuals showed statistical associations (*) and underrepresentation (**). The detailed operations for these groups are described in the supplementary file (*Appendix 8A*).

procedures.

Outcomes

To evaluate the effectiveness of FFP treatments, both subjective and objective outcomes were assessed, with the outcomes grouped into key categories for clarity. As presented in *Table 3–1*, mobility and functional outcomes were the most frequently evaluated objective outcome, appearing in 69 studies (59.0%), followed by hospitalization and length of stay (58 studies, 49.6%), mortality, and patient status and living conditions (48 studies, 41.0%).

Table 3–2 summarizes subjective outcomes, where pain (VAS, NRS) was the most utilized, appearing in 69/117 studies (59.0%). Patient-reported outcomes (PROs), defined using FBA [21], were employed in 34.2% of studies, primarily in the screw fixation group (37/126, 29.4%). The widespread use of pain (VAS, NRS) and PRO (126 and 93 operations) was consistent with the above indications (*Table 1C*), and outcome assessments would comprehensively evaluate patient recovery and satisfaction. However, sacroplasty notably diverged from this trend.

Table 3–1
The reference counts of the objective outcomes.

Objective outcomes	Reference count	Ratio (%)
Mobility and functional outcomes	69	59.0
Hospitalization and length of stay	58	49.6
Mortality	48	41.0
Patient status and living conditions	48	41.0
Procedure time	35	29.9
Ambulation	32	27.4
Bone healing and union	29	24.8
Reduction quality	23	19.7
Blood loss	22	18.8
Radiological outcomes	22	18.8
Cement amount and distribution	18	15.4
Surgical timing and pre/post-op management	18	15.4
Analgesic use	17	14.5
Screw number and position	15	12.8
Weight-bearing ability	12	10.3
Implant positioning	10	8.5
Costs and economic outcomes	8	6.8
Bone nutritional and metabolic outcomes	6	5.1
Discharge and readmission	6	5.1
NA	4	3.4

The detailed words for these groups are described in the supplementary file (*Appendix 8B*).

Table 3–2
The reference counts of the subjective outcomes and Cross table between treatment type and classification.

	VAS, NRS	PRO	Non-scoring Pain, Satisfaction	Pain anatomical location	Total
Reference count	69	40	27	8	
Rate (%)	59.0	34.2	23.1	6.8	
Treatment type					
Augmentation screw	7	5	2		14
Combination approaches	15	14	3	2	34
External fixation	7	4			11
INFIX	9	10		1	20
Plate osteosynthesis	14	13	3	2	32
Sacroplasty	26	8**	15*	2	51
Screw fixation	37	29	7	3	76
Spinopelvic fixation	6	6	1		13
NA 1)	5	4	6*	3*	18
Total	126	93	37	13	269

Total references ($n = 117$) differed from the total numbers in the reason for duplicates per reference.
1) NA includes non-surgical treatments and surgical cases without details of the procedures. The detailed words are described in the supplementary file (Appendix 8C).
Using the Chi-square test, the standardized residuals showed statistical associations (*) and underrepresentation (**).

Unlike other treatments, sacroplasty often lacked standardized scoring measures in outcome assessments, instead relying on non-scoring metrics such as qualitative pain or satisfaction indicators. This inconsistency highlights the need for standardized assessment tools to ensure comparability across studies and procedures.

Outcomes of complications

Table 3–3 outlines various complications observed in the studies, with 29% of the complications reported as non-surgical outcomes. General infections were the most frequently reported complications (45 counts, 38.5%), followed by thromboembolic events (34 counts, 29.1%) and bleeding or hemorrhage (32 counts, 27.4%). Surgical complications included superficial infections (39 counts, 33.3%), reoperations or revision surgeries (27 counts, 23.1%), and cement leakage (24 counts, 20.5%).

Discussion

This study is the first scoping review of FFP focusing on indications, treatment strategies, and outcomes. It highlights the lack of robust evidence, emerging treatments with limited evidence, and the absence of established guidelines.

Fracture name and classification

This scoping review identified two primary groups. The dominant fracture name group was “fragility fracture of the pelvis” (64.1%), with the FFP classification being the most frequently employed classification system (51.8%). Additional treatment indicators in this group focused on immobility (44.4%) and pain, measured using VAS, NRS (37.6%). "Fragility fracture of the pelvis" was statistically associated with the FFP classification, demonstrating moderate-to-substantial reliability [22]. As a result, a consensus has been established, both internationally and domestically, to utilise the FFP classification alongside immobility and pain assessments (VAS, NRS) to guide treatment [8,14]. The second dominant fracture name group was “sacral insufficiency fracture” (36.8%). In this group, the FFP classification was not applied; instead, pain (VAS, NRS) served as the primary treatment indicator in over half the cases (51.2%), demonstrating a statistically strong association.

Table 3–3
The reference counts of the complications.

Complications	Reference count	Ratio (%)
General infection	45	38.5
Superficial infection	39	33.3
Thromboembolic events	34	29.1
Bleeding and hemorrhage	32	27.4
Bone-related complications	29	24.8
Reoperations and revision surgery	27	23.1
Cement leakage	24	20.5
Screw loosening	21	17.9
Implant malposition	19	16.2
Neurological complications	18	15.4
Cement-related nerve or vascular injury	17	14.5
Screw perforation	17	14.5
Pressure-related complications	15	12.8
Implant loosening	14	12.0
Implant infection	14	12.0
Implant failure or breakage	14	12.0
Cardiovascular complications	13	11.1
Renal and urinary complications	10	8.5
Other general complications	14	12.0
Systemic complications	9	7.7
Pulmonary complications	8	6.8
Screw failure or breakage	8	6.8
Gastrointestinal complications	6	5.1
Implant-related complications	6	5.1
Cement extrusion	4	3.4
NA	19	16.2

The detailed complications for these groups are described in the supplementary file (Appendix 8D).

Treatment: surgical treatment divided into ORIF and sacroplasty groups

Conservative management was generally the first-line intervention for FFP, focusing on pain control and mobility restoration while aligning with current guidelines. An initial period of conservative management was often observed, even for patients with eventual surgical indications, although the protocols for duration and weight-bearing recommendations lacked standardization. Surgical interventions were broadly divided into two groups based on classification and treatment criteria: (A) the ORIF Group, which was guided primarily by the FFP classification, and (B) the Sacroplasty Group, where pain and mobility assessments were the primary indicators, though the criteria for surgical indications were inconsistent.

(A) ORIF Group

The FFP classification served as the primary fracture classification (51.8%) and the gold standard for this group, providing clear guidelines for ORIF procedures such as screw fixation, combination approaches, sacroplasty, plate osteosynthesis, spinopelvic fixation, augmentation screws, INFIX, and external fixation. Despite its limitations—such as excluding certain surgical cement-augmentation applications—the FFP classification is well-supported by established literature and clinical guidelines. This reinforces its use for managing complex fractures and treatment planning, as discussed earlier in the section on fracture classifications.

(B) Sacroplasty Group

In contrast, sacroplasty was statistically underrepresented in studies using the FFP classification and primarily associated with pain (VAS, NRS) as indications and non-scoring outcomes. Posterior-focused classifications like the Denis classification were sometimes used. However, their focus on the sacrum alone may neglect the pelvic ring’s complex structure. This reliance on subjective assessments of pain and mobility, as highlighted in the Practice Parameter for Vertebral Augmentation 2022 [23], often leaves decision-making largely at the surgeon’s discretion. Sacroplasty should gain attention as a treatment option for ‘H-shaped’ sacral insufficiency fractures, which may feature invisible fracture lines or progress into FFP Type IVb fractures [24]. It would be highly beneficial for sacroplasty to serve as an alternative to more invasive procedures for Type IVb fractures, such as spinopelvic fixation, bilateral iliac screws, or trans-iliac rod fixation. Building evidence through the FFP classification, which accounts for anatomical and biomechanical factors, and conducting comparative studies with the ORIF Group would help establish sacroplasty’s role. A more structured framework is essential to address diagnostic gaps and ensure comprehensive treatment planning for these interventions.

(C) Other fracture classification trends.

When utilizing the AO/OTA or Tile fracture classification, it was observed that fracture types within the literature were notably diverse rather than singular (Appendix 9C). 38% of the studies also tended to use it alongside the FFP classification. This parallel usage suggests that the AO/OTA classification is often employed to determine the most appropriate surgical intervention based on the specific fracture type. In contrast, the Young-Burgess classification addressed LC1 fractures (7/8) in Appendix 9D; the other was LC2 fractures (1/8). Its similarity to FFP classification Type 2b is one reason for its use, as these cases often present challenges in determining whether surgical or conservative management is appropriate. These might be attributed to the fact that

the classification has been used since 1990 and is considered more intuitive and easier to apply by many orthopaedic surgeons.

Outcomes for FFP

In this scoping review, we categorized the numerous outcomes into three groups: (A) Objective outcomes, (B) Consistent PROs (VAS, ADL-PROs) in subjective outcomes, and (C) Complications of surgical and non-surgical procedures. Outcomes were emphasized by prioritizing PROs and quantitative evaluations to support guideline formulation and establish evidence levels for systematic reviews or guidelines [25,26].

(A) Objective outcomes

Objective outcomes commonly evaluated include mobility and functional status (59.0%), hospitalization length (49.6%), mortality (41.0%), and patient status and living conditions (41.0%). These outcomes focused on patients' ADL and quality of life, similar to evaluations for other types of fractures. Additional surgical aspects evaluated encompassed procedure time (29.9%), bone healing and union (24.8%), reduction quality (19.7%), and blood loss (18.8%). Incorporating objective outcomes into evaluation criteria is expected to enhance the accuracy of assessments, addressing concerns like those raised with subjective outcomes [27,28].

(B) Consistent PROs (VAS, ADL-PROs) in subjective outcomes

The PROs focusing on pain and mobility assessments, such as VAS (59.0%) and ADL-PROs (34.2%), were frequently and consistently reported treatment outcomes from indications. However, there was limited consensus on the most appropriate ADL-PROs. Commonly used tools, such as the Majeed score, Oswestry Disability Index, and EQ-5D, were detailed in *Appendix 8C*. While widely utilized, these PROs face limitations when applied to elderly patients who may experience cognitive and physical challenges. Objective monitoring tools, such as vital signs, EEG, and pedometers, could supplement PROs to provide a more comprehensive assessment of recovery [29,30]. Comprehensive outcome evaluations should incorporate both objective measures and consistent PROs to assess treatment trajectories and effectiveness, addressing recruitment challenges observed in previous RCTs and ASSERT studies [28,31,32].

(C) Complications: surgical and non-surgical events

Surgical and non-surgical complications (including internal medicine issues, 29%) significantly impact long-term survival and are integral to understanding prognosis and adverse events in FFPs [33]. Previous systematic reviews have demonstrated correlations between surgical complications—such as urinary tract infections, anemia resulting from surgical bleeding, and surgical site infections—and mortality. These findings underscored the importance of tracking surgical and non-surgical complications [4,6,34]. These complications were also frequently reported but differed from PROs, providing additional insights into the prognosis and risks associated with FFP management.

Highlights and limitations of this scoping review

This scoping review highlights the urgent need for explicit treatment guidelines, particularly for sacral insufficiency fractures and cement augmentation treatments. The methodology adhered to a rigorous, preregistered protocol and included a comprehensive literature search based on currently available evidence. Notably, when the search criteria extended beyond "fragility fracture of the pelvis," irreconcilable inconsistencies emerged among the studies. A limitation of this review was its primary focus on literature discussing treatment interventions, excluding epidemiological studies. Including such studies could potentially alter the observed proportions of fracture names, classifications, and outcomes. Further research is essential to standardize definitions and broaden perspectives in FFP management to address these gaps effectively.

Conclusion

This scoping review highlights the critical role of the FFP classification in guiding treatment strategies for FFP, supporting a shift from conservative management to surgical options when necessary. However, the lack of standardized indications and outcome measures - particularly for cement augmentation and sacroplasty - continues to hinder comparability across studies. Consistent use of tools such as VAS and ADL-PROs for treatment indications and objective assessments may be key to establishing clear and evidence-based guidelines. Future research should prioritize the standardization of treatment indications and outcome measures to support evidence-based policies. These efforts are essential to improving patient care and recovery outcomes in FFP management.

Ethics statement

This scoping review is based solely on data extracted from previously conducted studies available in the public domain. Ethical approval was not required because no new data collection or interaction with human participants was involved.

CRediT authorship contribution statement

Kaori Endo: Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Norio Yamamoto:** Writing – review & editing, Visualization, Validation, Supervision, Data curation, Conceptualization. **Shunsuke Taito:** Writing – review & editing, Validation, Supervision, Project administration, Methodology. **Takahiro Tsuge:** Writing – review & editing, Validation, Methodology, Investigation, Formal analysis, Data curation. **Yuki Nakashima:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation. **Kosuke Suzuki:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation. **Takao Kaneko:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation. **Kae Okoshi:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.injury.2025.112206.

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