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Recent Trends in the Management of Osteoporotic Fractures in the Elderly Population — A Review Article

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ABSTRACT:

Osteoporotic fractures represent a major cause of morbidity, disability, and mortality in the elderly population worldwide. With increasing life expectancy, the burden of fragility fractures—particularly hip, vertebral, and distal radius fractures—has risen substantially. Osteoporosis is characterised by decreased bone mineral density (BMD) and deterioration of bone microarchitecture, leading to increased fracture susceptibility. Early diagnosis, preventive strategies, and modern therapeutic interventions play a critical role in improving patient outcomes. Recent advances in the management of osteoporotic fractures include improved screening methods, risk prediction tools, minimally invasive surgical techniques, fracture liaison services, bone-targeted pharmacological therapies, and anabolic agents. This review summarises the current understanding of pathophysiology, risk assessment, diagnostic approaches, conservative and surgical treatment, pharmacological therapies, rehabilitation, and emerging technologies in the management of osteoporotic fractures in elderly patients. Emphasis is placed on multidisciplinary care and secondary fracture prevention strategies to reduce mortality and improve quality of life.

INTRODUCTION

Osteoporosis is a systemic skeletal disorder characterized by low bone mass and microarchitectural deterioration of bone tissue, resulting in increased bone fragility and fracture risk (1). It is one of the most common metabolic bone diseases affecting the geriatric population and is often called a “silent disease” because it remains asymptomatic until a fracture occurs (2).

Globally, approximately 200 million individuals are affected by osteoporosis, and a fragility fracture occurs every few seconds (3). The incidence increases significantly after 60 years of age, especially in postmenopausal women and elderly men (4). Hip, vertebral, and distal radius fractures are the most frequent osteoporotic fractures and are associated with increased mortality and reduced functional independence (5). Hip fractures in particular are associated with a 20–30% one-year mortality rate (6).

The rising geriatric population has resulted in a substantial socioeconomic burden due to hospitalization, surgical treatment, long-term rehabilitation, and loss of productivity (7). Therefore, management of osteoporotic fractures not only involves fracture fixation but also requires prevention of secondary fractures, optimization of bone health, and rehabilitation.

Recent decades have seen remarkable advances in screening methods, pharmacologic therapies, minimally invasive surgery, and multidisciplinary care pathways such as fracture liaison services (8). This review

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discusses the recent trends in diagnosis, treatment, and prevention of osteoporotic fractures in elderly patients.

Methodology

This review was conducted using literature published between 2000 and 2025 retrieved from PubMed, Scopus, Google Scholar, and Cochrane Library databases. Keywords used included “osteoporotic fractures,” “fragility fractures,” “elderly,” “osteoporosis treatment,” “bisphosphonates,” “teriparatide,” “denosumab,” and “fracture liaison service.” Randomized controlled trials, systematic reviews, meta-analyses, and clinical guidelines were included. Non-English articles and case reports were excluded.

Pathophysiology of Osteoporotic Fractures

Bone remodeling is a continuous process involving osteoclastic bone resorption and osteoblastic bone formation. In osteoporosis, bone resorption exceeds bone formation (9). Aging, estrogen deficiency, reduced calcium absorption, and vitamin D deficiency contribute to decreased BMD (10).

Trabecular bone is affected earlier than cortical bone, making vertebrae and femoral neck particularly susceptible to fractures (11). Other contributing factors include:

- Hormonal deficiency (estrogen, testosterone)
- Reduced physical activity
- Chronic diseases
- Long-term corticosteroid therapy
- Nutritional deficiency (12)

Risk Factors

Major risk factors for osteoporotic fractures include:

Non-modifiable

- Advanced age
- Female gender
- Genetic predisposition
- Previous fragility fracture

Modifiable

- Smoking
- Alcohol intake
- Vitamin D deficiency
- Low body mass index
- Sedentary lifestyle
- Long-term steroid use (13)

Clinical Presentation

Osteoporotic fractures commonly present as:

1. **Vertebral fractures:** Back pain, kyphosis, height loss
2. **Hip fractures:** Inability to bear weight, limb shortening and external rotation
3. **Distal radius fractures:** Fall on outstretched hand (14)

Many vertebral fractures remain undiagnosed and are detected incidentally on imaging (15).

Diagnosis and Evaluation

Bone Mineral Density

Dual-energy X-ray absorptiometry (DEXA) is the gold standard diagnostic test (16).

WHO Criteria:

- Normal: T-score ≥ -1
- Osteopenia: -1 to -2.5
- Osteoporosis: ≤ -2.5 (17)

Fracture Risk Assessment

FRAX tool estimates 10-year fracture probability based on clinical risk factors and BMD (18).

Laboratory Tests

- Serum calcium
- Vitamin D
- Parathyroid hormone
- Bone turnover markers (19)

Management of Osteoporotic Fractures

1. Conservative Treatment

Indicated in stable fractures.

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Includes:

- Analgesics
- Bracing
- Physiotherapy
- Early mobilization (20)

2. Surgical Management

Hip Fractures

Early surgery within 24–48 hours reduces mortality (21).

Options:

- Hemiarthroplasty
- Total hip arthroplasty
- Intramedullary nailing

Vertebral Compression Fractures

- Vertebroplasty
- Kyphoplasty (22)

Distal Radius Fractures

- Volar locking plate fixation (23)

Modern implants are designed for osteoporotic bone with angular stability.

Pharmacological Management

Calcium and Vitamin D

Essential for all patients (24).

Bisphosphonates

First-line therapy:

- Alendronate
- Risedronate
- Zoledronic acid

They inhibit osteoclast activity and reduce fracture risk (25).

Denosumab

Monoclonal antibody against RANKL; decreases bone resorption (26).

Selective Estrogen Receptor Modulators

Raloxifene reduces vertebral fractures (27).

Anabolic Agents

Teriparatide stimulates osteoblast activity and enhances fracture healing (28).

Romosozumab

New sclerostin inhibitor increasing bone formation (29).

Recent Advances and Emerging Trends

Fracture Liaison Services (FLS)

Coordinated post-fracture care programs that reduce secondary fractures (30).

Minimally Invasive Surgery

- Percutaneous fixation
- Cement augmentation
- Augmented pedicle screws (31)

Biological and Regenerative Therapy

- Stem cell therapy
- Bone morphogenetic proteins (32)

Artificial Intelligence

AI-based imaging tools help predict fracture risk and assist early diagnosis (33).

Fall Prevention Programs

Balance training and home safety interventions significantly reduce fracture incidence (34).

Rehabilitation

Early mobilization is essential to prevent complications such as:

- Deep vein thrombosis
- Pneumonia
- Pressure sores (35)

Weight-bearing exercises improve BMD and functional recovery (36).

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Prevention Strategies

- Adequate calcium intake
- Vitamin D supplementation
- Exercise
- Fall prevention
- Regular screening (37)

Secondary prevention after first fracture is critical (38).

Discussion

Osteoporotic fractures are not merely orthopedic injuries but a geriatric syndrome requiring multidisciplinary management. Surgical fixation alone does not address the underlying disease, and many patients experience recurrent fractures. Studies show that initiation of anti-osteoporotic therapy after a fragility fracture significantly reduces future fracture risk.

Recent pharmacological therapies, particularly anabolic agents such as teriparatide and monoclonal antibodies like denosumab, have revolutionized management by improving bone quality and fracture healing. Minimally invasive surgical methods and augmentation techniques improve fixation stability in osteoporotic bone.

Fracture liaison services have emerged as one of the most effective interventions for secondary prevention. Combining pharmacological therapy, fall prevention, rehabilitation, and nutritional optimization provides the best outcomes.

Conclusion

Osteoporotic fractures are a major public health concern in the elderly population. Early diagnosis, prompt surgical management, and aggressive secondary prevention are essential. Modern treatment strategies now emphasize a comprehensive approach that includes pharmacologic therapy, minimally invasive surgery, rehabilitation, and prevention programs. Implementation of fracture liaison services and newer anabolic therapies has significantly improved patient outcomes. Future research focusing on biological therapies and personalized medicine may further reduce fracture burden and improve quality of life.

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