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Strategies for Preventing Proximal Femoral Fractures in the Geriatric Population

Günbay Noyan Dirlik

Department of Orthopedics and Traumatology, Alanya Training and Research Hospital, Antalya, Türkiye

ABSTRACT

Proximal femoral fractures (PFFs), commonly referred to as hip fractures, represent a significant yet largely preventable health concern in the elderly population. These injuries are associated with substantial morbidity and mortality, often leading to long-term disability, loss of independence, and reduced quality of life. Moreover, PFFs impose a considerable economic and social burden on healthcare systems and caregivers due to prolonged hospitalizations, extensive rehabilitation, and the need for long-term care. As global life expectancy continues to rise and the proportion of elderly individuals increases, the incidence of PFFs is expected to grow accordingly. The majority of these fractures result from low-energy trauma, most often due to falls in individuals with underlying osteoporosis. Therefore, PFFs are not only an orthopedic issue but also a major public health challenge requiring a multidisciplinary approach. In this review, we explore the etiology and risk factors associated with PFFs as a major public health concern and highlight evidence-based preventive strategies for this vulnerable age group.

Keywords: Femoral fractures, fracture prevention, geriatrics, osteoporosis.

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Address for correspondence:
Günbay Noyan Dirlik, Department of Orthopedics and Traumatology, Alanya Training and Research Hospital, Antalya, Türkiye
E-mail: ndirlik@gmail.com

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INTRODUCTION

Proximal femoral fractures (PFFs) are a significant cause of mortality and morbidity in the geriatric population. These fractures present a major social and economic burden. With increasing life expectancy, the size of the elderly population continues to grow. Consequently, the incidence of geriatric PFFs is expected to rise, leading to increased mortality, morbidity, and associated social and economic problems.[1-6]

Epidemiology of Proximal Femoral Fractures and Treatment

The risk of PFFs increases with age. The incidence is approximately 2 per 100,000 in women under the age of 35 and 4 per 100,000 in men. In contrast, the incidence rises significantly to an estimated 3,032 per 100,000 in women over the age of 85, and 190 per 100,000 in men.[7]

Patients with PFFs require hospitalization. During admission, necessary treatments and consultations are carried out for comorbid conditions. The majority of fractures in this population are managed surgically. Anatomically, the proximal femur is divided into the femoral head, femoral neck, trochanteric region, and subtrochanteric region. Fractures most commonly occur in the femoral neck and intertrochanteric region. Surgical and postoperative care protocols vary depending on the specific site of the fracture. Postoperative management may include intensive care, and individualized physiotherapy is essential during the recovery period. Recovery after discharge is often prolonged and requires regular outpatient follow-up. Several studies have demonstrated that PFFs can be effectively prevented in the elderly. Given the high rates of mortality and morbidity associated with these fractures, prevention is of paramount importance in this patient population.[4,5,8-15]

Etiology

Falls and osteoporosis are the leading causes of PFFs, with approximately 85% of cases occurring after a fall. Multiple strategies have been developed to prevent falls. All patients should be evaluated for contributing factors for falls, including visual impairments, middle ear disorders, cerebrovascular disease, cardiac conditions that may cause syncope, and epilepsy. Appropriate precautions should be taken to reduce the risk of falling, whether at home or in a nursing facility.[15-17]

The risk of fracture increases with osteoporosis due to reduced bone density. The fracture risk rises by 2.6-fold for each standard deviation (SD) decrease in bone mineral density (BMD). Therefore, identifying and treating osteoporosis is of critical importance. Other factors that predispose individuals to PFFs include osteoarthritis, reduced muscle strength, peripheral neuropathy, impaired proprioception, slower walking speed, malnutrition, delayed reaction time, Parkinson's disease, and alcohol use.[15,16,18]

The global geriatric population is gradually increasing, and the incidence of PFFs is expected to rise accordingly in the coming years. Preventing PFFs is associated with reduced mortality and morbidity, as well as a decrease in related social and economic burdens. In this review, we discuss the etiology and management of PFFs and recommend preventive strategies for the elderly.[3,6]

Preventing Fractures Due to Falls

Falls are among the most common and serious problems in the elderly. They occur when an individual loses their center of gravity and either fails to attempt to maintain balance or their efforts are insufficient. Falls can also result from a loss of consciousness. The etiology of PFFs in this population is considered multifactorial. One-third of individuals over the age of 65 fall at least once per year, and this rate increases significantly after the age of 75. Women fall 2.7 times more often than men, and fractures occur in about 1% of these cases. Thus, women are at greater risk. In the elderly, a large proportion of PFFs occur as a result of falls. Preventing falls not only helps reduce the incidence of PFFs but also decreases the risk of other fractures of the appendicular skeleton, such as distal radial and humeral fractures. Falls in the elderly can be broadly categorized into two types: those caused by environmental factors (accidental falls) and those caused by patient-related factors. Accidental falls are caused by environmental factors such as obstacles in walking paths or slippery surfaces. Patient-related factors are associated with conditions that develop due to aging and comorbid diseases. Environmental factors are particularly significant, accounting for 30% to 50% of falls. These include wet or slippery walking surfaces, the use of slippery shoe insoles, obstacles on the ground, inadequate traffic regulations, stair design, poor lighting, and insufficient landscaping. Therefore, it is critical to educate patients, their families, and nursing home staff about fall prevention. Environmental interventions should be planned to minimize fall risk. Footwear used both at home and outdoors should be chosen carefully. The use of canes or walking sticks should be encouraged, as they are effective in preventing falls. Recently, the use of hip protective orthoses has become more widespread. These devices have been shown to be effective in reducing fractures resulting from falls.[15,16,19-29]

Among patient-related factors, age is the most significant. As age increases, the frequency of falls also rises. While 28% to 35% of individuals over the age of 65 experience a fall each year, this rate increases to 40% in those over the age of 75. Female sex is another risk factor. A study conducted in the United States showed that women over the age of 70 fell more frequently and were twice as likely to sustain injuries compared to men. Additionally, various systemic conditions, either individually or in combination, can predispose patients to falls. These conditions should be thoroughly assessed and recognized by clinicians. Neurological disorders that increase fall risk include dementia, cerebrovascular disease, transient ischemic attacks, Parkinson's disease, delirium, and vestibular system disorders. Cardiovascular causes include myocardial infarction, orthostatic hypotension, and arrhythmias that may lead to syncope. Gastrointestinal conditions such as diarrhea and hemorrhages can also contribute. Internal disorders including thyroid disease, hypoglycemia, hypokalemia, hyponatremia, hypernatremia, dehydration, and anemia are additional risk factors. Degenerative musculoskeletal diseases, myopathies, and spinal deformities can further increase fall risk. Moreover, genitourinary problems such as urinary incontinence and post-micturition hypotension have also been associated with an increased risk of falls. Depression and anxiety are among the psychiatric conditions that predispose individuals to falls. Visual impairments, such as cataracts, myopia, hyperopia, and other vision disorders, are also associated with an increased risk of falling. Healthcare professionals should remain vigilant in identifying these conditions in geriatric patients. Regular screening and appropriate treatment should be implemented, as proper recognition and management can reduce the risk of PFFs.[15,16,23,30-45]

In clinical practice, elderly patients should be routinely assessed for fall risk. Patients who have experienced one fall per year or less and do not have significant comorbidities may only require monitoring. However, patients who fall more than once per year should be evaluated for underlying systemic conditions. If such conditions are identified, appropriate treatment should be initiated. Managing fall risk in the elderly requires a multidisciplinary approach involving geriatricians, physiotherapists, social workers, and orthopedic specialists.[15,16,19,20,46]

Table 1. Classification of Fall Risk Factors: Intrinsic and Extrinsic

Intrinsic Risk Factors (Patient-Related)	Extrinsic Risk Factors (Environment-Related)
Advanced age (≥75 years)	Slippery or wet floors
Female sex	Poor lighting
Muscle weakness	Obstacles on walking paths (e.g., rugs, uneven surfaces)
Visual impairments (e.g., cataracts, myopia, hyperopia)	Inadequate stair design and handrails
Neurological disorders (Parkinson's disease, dementia, stroke)	Improper footwear (e.g., smooth soles)
Cardiovascular conditions (orthostatic hypotension, arrhythmias)	Cluttered home environment
Metabolic imbalances (e.g., hyponatremia, hypoglycemia)	Inappropriate furniture layout
Musculoskeletal disorders (e.g., arthritis, spinal deformities)	Lack of bathroom safety equipment (e.g., grab bars)
Urinary incontinence, post-micturition hypotension	Unmarked elevation differences in flooring
Psychiatric conditions (depression, anxiety)	Inadequate community infrastructure (e.g., poor sidewalks)
Medication side effects (sedatives, antihypertensives)	Icy outdoor surfaces
Vitamin D deficiency	Absence of assistive devices when needed (e.g., cane, walker)

With aging, the musculoskeletal system weakens. Multiple studies have demonstrated that physiotherapy and exercise have positive effects in preventing falls in this population. Exercise has been also associated with increased bone mass (Table 1).[16,46-49]

Osteoporosis

Osteoporosis is characterized by a decrease in BMD and deterioration of bone microarchitecture. It occurs as a result of advanced age, menopause, and metabolic disorders. Diagnosis is made using dual-energy X-ray absorptiometry (DEXA). A T-score of less than -2.5 is diagnostic for osteoporosis. Osteoporosis is a risk factor for PFFs. For every 1 standard deviation decrease in T-score, the risk of fracture increases by 2.6 times. Multidisciplinary treatment is necessary and has been shown to reduce the risk of PFFs when initiated. It is important to note that the majority of PFFs occur in women with normal BMD values. An estimated 200 million individuals worldwide have osteoporosis. Each year, approximately 1.5 million people experience osteoporotic fractures, with the most common being vertebral fractures and PFFs. While vertebral fractures are often not caused by falls, PFFs typically result from falls. These fractures affect women four times more often than men. Additionally, PFFs due to osteoporosis most commonly occur between the seventh and eighth decades of life.[15,26,50-58]

Risk factors include a sedentary lifestyle, smoking, low body mass index (BMI), low protein intake, alcohol use, family history, premature menopause, genetic factors, malabsorption syndromes, liver diseases, diabetes mellitus, cancer, chronic kidney disease, rheumatoid arthritis, use of phenytoin, antineoplastic agents, antiretroviral therapy, cyclosporine, and furosemide.[56,59]

Osteoporosis Treatment

Lifestyle and dietary modifications are recommended for all patients. Pharmacological treatment is advised for patients with osteoporosis. Treatment options include calcium, vitamin D, bisphosphonates, estrogen-progestin preparations, estrogen, salmon calcitonin, raloxifene, teriparatide, and denosumab.[60–64]

Calcium and Vitamin D: Adequate levels of calcium and vitamin D should be obtained through the diet. This is considered the first step in pharmacological treatment. The use of vitamin D has been shown to reduce the risk of falls by up to 70%. Muscle strength significantly increases within six months of treatment.[60,61,65,66]

Bisphosphonates: Bisphosphonates are considered first-line treatment. They are potent antiresorptive agents recommended for all patients with a T-score lower than -2.5. Treatment is also indicated for individuals with a T-score between -1.0 and -2.5 if the 10-year risk of hip fracture is greater than 3%, according to the World Health Organization (WHO) FRAX® algorithm, or if the risk of any major osteoporotic fracture exceeds 20%. These agents work by binding to osteoclasts and inhibiting bone resorption. Alendronate, risedronate, and ibandronate have been shown to reduce the risk of PFFs. Weekly dosing is preferred to minimize gastrointestinal side effects. Common adverse effects include esophagitis, dysphagia, gastric ulcers, osteonecrosis of the jaw, and atypical subtrochanteric femoral fractures.[15,16,63,64,67-69]

Estrogens: Estrogen-progestin replacement therapy is used in type 1 menopause. These agents reduce the risk of hip fractures, although they may slightly increase the risk of breast cancer. Raloxifene, a selective estrogen receptor modulator, reduces vertebral fractures but has no effect on hip fracture risk.[16,70]

Raloxifene: Raloxifene is a selective estrogen receptor modulator that decreases bone resorption. While it reduces the risk of vertebral fractures, it does not lower the risk of PFFs.[71]

Teriparatide: Teriparatide is used in the treatment of advanced osteoporosis. It acts by stimulating osteoblasts and renal tubular cells. Administered subcutaneously, it may cause dizziness and headache. It is contraindicated in patients with Paget's disease.[72,73]

Denosumab: Denosumab is a monoclonal antibody that inhibits the receptor activator of nuclear factor-kappa B ligand (RANKL), thereby preventing osteoclast formation. It is administered subcutaneously and has been shown to reduce the risk of hip fractures by 40%. Adverse effects may include arthralgia, nasopharyngitis, low back pain, and osteonecrosis of the jaw.[74,75]

CONCLUSION

Proximal femoral fractures are preventable conditions in the elderly. The most common causes are falls and osteoporosis. A multidisciplinary approach is essential for fall prevention in this population. Patients, families, and caregivers should receive education, and nursing homes should be made aware of fall risks. Exercise has been shown to prevent both falls and fractures. Age-appropriate physiotherapy should be implemented. The use of appropriate footwear and clothing that reduces fall risk should be encouraged. Living environments should be adapted to enhance safety and minimize fall hazards. During clinical visits, patients should be asked about the frequency of falls over the past year. If they report more than one fall, they should be screened for systemic diseases and treated as necessary. Lifestyle modifications should be advised, including smoking and alcohol cessation if applicable. Nutrition should be assessed, and a diet rich in vitamin D and calcium should be recommended. All elderly patients should be screened for osteoporosis and treated when indicated. We believe that implementing appropriate preventive measures can significantly reduce PFF-related mortality and morbidity, as well as the associated social and economic burden. Given the anticipated growth of the geriatric population, meticulous and proactive strategies are urgently needed to prevent PFFs (Fig. 1).

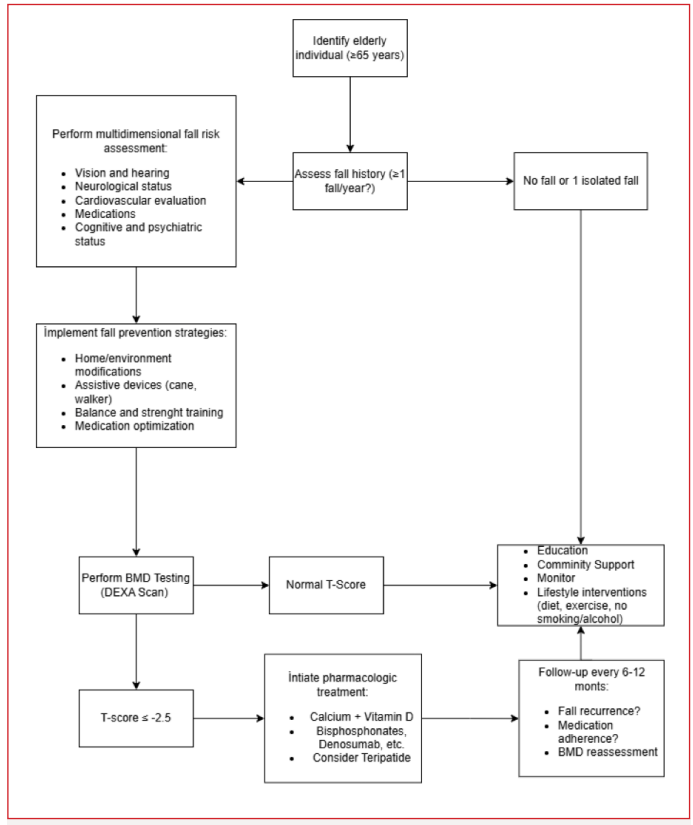

Figure 1. Algorithm for Fall Risk and Osteoporosis Management in the Geriatric Population.

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