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# Fragility Fracture of Proximal Tibia in A Wheelchair-Bound 54-Year-Old Female Patient

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**A B S T R A C T**

Sedentary behavior is one of the risk factors of fracture, in which mild activity was found to be inversely associated with hip, vertebral, and total fracture. Other study also found non-linear association of fracture risk with lower and higher physical activity was associated with higher risk of any fracture compared to a mean physical activity. In this study, we reported a 54-year-old wheelchair bound female with fracture on the proximal tibia cause by low-energy trauma. This research underscores the importance of early identification of fracture risk factors, especially in vulnerable populations such as older adults who are wheelchair-bound. Early interventions that include lifestyle changes, increased physical activity, and nutritional management are essential to prevent further fractures and improve bone health. Identifying the risk of fractures on elderly patient may be beneficial for prevention of fractures especially in wheelchair-bound elderly individual.

## 1. Introduction

Sedentary behavior is one of the risk factors of fracture, in which mild activity was found to be inversely associated with hip, vertebral, and total fracture [1], [2]. Other studies also found non-linear association of fracture risk with lower and higher physical activity was associated with higher risk of any fracture compared to a mean physical activity [3] . In older patients, physical inactivity combined with physiology of old age, female gender, history of previous fracture, and other behavioral fracture can increase the risk of fractures [4], [5]. The association of physical inactivity with fracture risk may be explained by decreasing bone health due to osteoporosis [6]. In osteoporotic bone, there are fewer trabeculae in trabeculae bone, changes in trabecular thickness and changes in heterogenicity which decreased the mechanical integrity of the bone and increases the risk of fractures [7].

Osteoporosis increases the risk of fragility fractures, which is fractures occur because of “low energy trauma”, often because of falls from standing height or less that would not normally result in fracture. Fragility fracture often involves the vertebral, proximal femur, distal forearm, and proximal humerus. On older person, there is also increased risk of falls caused by frailty which defined as “the state of increased vulnerability to poor resolution of homoeostasis after a stressor event, which increases the risk of adverse outcomes”. Frailty in older people consists of five variables, namely unintentional weight loss which is associated with chronic undernutrition, self-reported exhaustion, low-energy expenditure, slow walking speed, and weakness. The combination of the frail state and osteoporosis likely all contribute to fractures in older patients [8], [9] . In this study, we reported a 54-year-old wheelchair bound female with fracture on the proximal tibia cause by low-energy trauma.

## 2. Case Report

A 54-year-old female was presented to the emergency room with complaint of pain and swelling in the left calf for 1 hour before presented to the hospital. The patient had a history of ischemic stroke with very low daily activities that was mostly spent on the wheelchair. Before being presented to the hospital, the patient fell from her wheelchair to the floor [10]. The patient also had a history of hypertension, diabetes, and had undergone open reduction internal fixation (ORIF) in the ankle and the internal fixation is still attached. The vital signs examination showed a 208/138 blood pressure with accelerated heart rate of 110x/minute. Other vital signs are normal. Physical examination reveals a swelling of the left calf with tenderness and

limited active range of motion and passive range of motion then the patient underwent radiographic examination of the left calf Laboratory examination showed elevated levels of blood calcium, creatinine, glucose, and white blood cell (WBC) count. The patient was then diagnosed with an oblique fracture of the left tibia and hypertensive urgency.


Figure 1. X-ray of the patient's left thigh which shows an oblique fracture in the proximal region of the tibia.

## 3. Result and Discussion

Fragility fractures occur because of a low energy trauma, namely falls from a height which would normally would not result in a fracture. Fragility fractures most commonly occur in individuals with osteoporosis which is also commonly found in older people aged more than 50 years. The lifetime risk of osteoporotic fracture is 40-50% in women and 13-22% in men. Fragility fractures also lead to various adverse outcomes such as impaired outcomes, prolonged hospitalization, residual disability, and reduced life expectation. The most affected area in fragility fracture is the hip and spine, while other areas can also be affected such as the humerus, pelvis, forearm, ribs, distal femur, tibia, and clavicle. In older patient, frailty also contributes to the increasing risk of fractures [11], [12].

Frailty is defined by Fried and colleagues as "a biologic syndrome of decreased reserve and resistance to stressors, resulting from cumulative declines across multiple physiologic systems, and causing vulnerability to adverse outcomes" [13]. There are various risk factors that was found to be associated with frailty, such as older age, lower BMI, female sex, living alone, low levels of exercise, polypharmacy, somking status, drinking status, low vitamin D level, and malnutrition. Older adults that live alone may also be vulnerable in physical and psychosocial aspects and associated with higher prevalence of safety incidents sucha s falls and abuse [14], [15]. The state of frailty was reported to increase the immediate risk of fracture in elderly women, regardless of bone density compared to nonfrail women [16]. In patients that have already experienced fractures, there is further increased risk of frailty, which in turn also increased the risk of fracture-related readmission, death, and death post fracture-related readmission [16]. This may explain the readmission of the patient in this study.

Our patient was wheelchair-bound because of her previous fractures. This may be a contributing factor to the readmission because of the sedentary behavior from being bound to the wheelchair. Being sedentary is defined as a lack of physical activity and social interactions, resulting in wanting to be more physically active than sometimes possible. A systematic review on 14 studies have shown that higher level of physical activity is associated with lower odds of frailty [17]. Another systematic review of 23 articles comprised of 7,696 participants over 60 years old also found that Lower moderate-to-vigorous and total physical activity, steps, postural transitions, and energy expenditure were associated with frailty [18]. Sedentary behaviour, independent of frailty state, also was reported to increase the risk of fracture in postmenopausal older women [10], [19].

The increased fracture risk on older people is also influenced by the presence of osteoporosis. Osteoporosis is defined as low bone mass, microarchitectural deterioration of bone tissue and decreased bone strength. The mechanism causing osteoporosis is mainly caused by bone loss because of aging/and or estrogen deficiency. Reductions in physical activity can also result in bone loss. Measurement of osteoporosis may include dual energy X-ray absorptiometry scanning and fracture risk assessment using various tools such as QFracture and FRAX [20]. In most areas of the world, the frequency of hip fractures is increased by 1%-3% per year of age with low bone density and previous fractures as the risk factor for almost all types of fracture [17]. In our study, combination of old age and low physical activity may also increase the risk of osteoporosis which leading to increased risk of fractures.

To reduce the risk of fractures, early identification of risk factors and appropriate management should be done especially in known vulnerable population such as the patient in our study. Currently there are no uniform recommendations and treatment should be individualized. General preventive strategies should be aimed for lifestyle changes, exercise, intake of calcium and vitamin D, and managing fall risk. Pharmacologic medication may include drugs that inhibits bone resorption, such as biphosponates, denosumab, calcitonin, estrogen and progesterone, or drugs that

stimulates bone formation [22]. To prevent further progression of frailty status, proper nutrition should be given which consisted of adequate protein, calories, and vitamin D. Physical exercise such as resistance-based exercise, balance and functional-based exercise such as Tai Chi may also slows the progression of frailty [22].

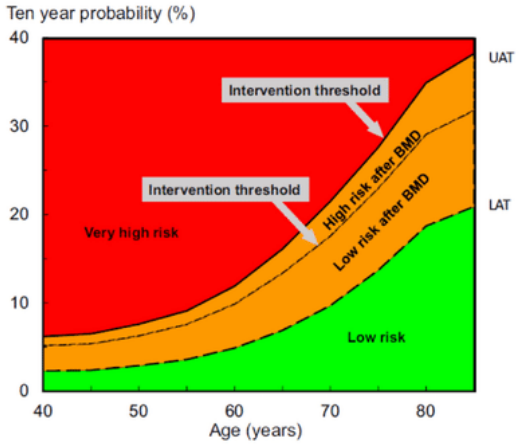


Figure 1. Ten-Year Fracture Probability Graph Based on FRAX in Postmenopausal Women with Intervention Threshold and BMD Assessment [23]

Figure 1 shows the fracture probability according to FRAX for major osteoporotic fractures in postmenopausal women. Fracture risk increases with age. FRAX probability in the red zone indicates a very high risk. FRAX probability in the green zone suggests a low risk, while FRAX probability in the orange zone (between the upper assessment threshold and lower assessment threshold) requires further evaluation with BMD (Bone Mineral Density) assessment and recalculation of FRAX probability including femoral neck BMD. Lower Assessment Threshold (LAT): The minimum risk level where further evaluation is recommended, but intervention is not yet required. Upper Assessment Threshold (UAT): The maximum risk level where medical intervention is recommended to reduce fracture risk.

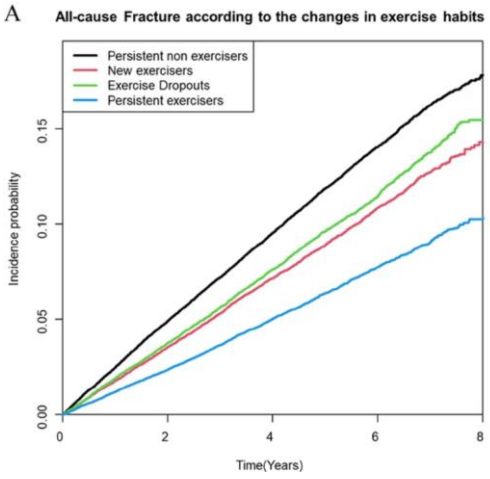


Figure 2. Fracture Probability Based on Changes in Exercise Habits Over 8 Years [24]

Figure 3 shows Incidence probability of fractures from all causes based on changes in exercise habits. The graph shows that individuals who have never exercised consistently have a higher probability of fracture over time, while individuals who exercise regularly have a lower probability of fracture. People who have recently started exercising or who have stopped exercising have fracture probabilities in between the two groups.

## 4. Conclusion

Older individuals are at increased risk of fractures which may be influenced by the state of frailty and decreased bone mass. Identifying the risk of fractures on elderly patient may be beneficial for prevention of fractures especially in wheelchair-bound elderly individual. Early intervention is important to prevent fractures in vulnerable population such as in the elderly. Behavioural risk factors must be addressed which includes sedentary behaviours and risk of falls or trauma, which can be modified to prevent further lowering of bone mass and reduce risk of fragility fractures. Pharmacologic treatment may also be done to further reduce risk of osteoporosis.

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