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Fracture Risk Assessment in Clinical Practice: Why Do It? What to Do It With?

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Abstract

Fracture is the outcome of concern in osteoporosis, and fracture reduction is the primary goal of osteoporosis treatment. Fracture risk assessment is a critical component in osteoporosis management. The earlier approach of deciding on whether to treat solely based on bone mineral density (BMD) T-scores has been supplanted by employing the concept of absolute risk over medium time periods and more encompassing integration of clinical risk factors with or without BMD into robust fracture risk assessment tools. Fracture risk estimation allows for identifying high-risk patient groups not only at a health system and population-based level and thereby allowing allocation of financial resources to the people most at risk, but also at an individual level for the clinician to involve the patient in shared decision-making processes for treatment. The process of fracture risk assessment involves several steps including performing a thorough history and physical examination, assessing BMD, doing radiological assessment for vertebral fractures, and laboratory evaluation to rule out secondary contributors to osteoporosis. The data thus obtained can be input into any one of several fracture risk assessment tools that are now available. The decision on which tool to use can be made on the background of country-specific guidelines, although it is imperative that the physician be aware of the limitations inherent to whichever tool is chosen. This article aims to provide a brief overview of why fracture risk estimation is important and the methods that can be employed for it by the physician in clinical practice.

Key Words: Clinical risk factors; fracture prediction; fracture risk; risk assessment tool.

Introduction

Osteoporosis is rapidly assuming epidemic proportions worldwide, and this health-care burden is expected to rise even further over the next several years because of increasing life expectancy and changes in lifestyle. Bone fragility, falls, and fractures form a continuous trajectory in osteoporosis, and multiple points exist along this precipitous path where interventions can be made. It is essential that new strategies be developed and existing strategies be fine-tuned to identify individuals at high risk of fracture so that the appropriate interventions targeted at this group can be made. The fracture risk assessment process helps to sort patients into different categories of risk, which in turn helps to determine appropriate next steps with respect to prevention and treatment. The development of validated fracture risk assessment tools has been a very promising step. It encourages physicians to shift their mindset and framework of decision-making from relying only on numerical bone mineral density (BMD) data that gave only the relative risk of fractures to a more quantitative and absolute fracture risk estimation that allows tailoring treatments to each patient's risk profile. This review will provide a brief overall view of why fracture risk estimation is important and the methods that can be used for it.

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The Why of Fracture Risk Estimation

It is important for both physicians and patients to have a clear vision of the magnitude of risk and the potential outcome of any medical condition. A fracture is the ultimate outcome of concern in osteoporosis, and the goal of osteoporosis treatment is fracture reduction. There are several reasons why it is imperative that fracture risk estimation be made an integral part of osteoporosis care. Osteoporosis-related fractures impose a substantial burden of disability, cost, and mortality in both men and women, and the grim statistics appear to be a worldwide phenomenon. In American women 55 years and older, the hospitalization burden of osteoporotic fractures and cost is greater than that of Myocardial Infarction, stroke, or breast cancer *(1)*. Vertebral fractures, the most common osteoporotic fracture, carry grave post-fracture consequences of deformity, reduced pulmonary function *(2)*, and diminished quality of life *(3)*. Within 1 year after sustaining a hip fracture, there is a 12%–30% excess mortality *(4–6)*, and roughly 20% of patients require nursing home placement *(6)*. Only 40% regain full independent function *(7)*. Distal forearm fractures are less likely per se to be associated with mortality or serious morbidity. However, poor to only fair recovery in functional outcome of the wrist and hand has been reported in up to 22.5% of patients after sustaining fractures of the distal forearm *(8)*. Thus, it seems logical that to reduce this burden, identification of individuals at high risk of fracturing is necessary so that appropriate intervention measures to attenuate their risk can be applied.

Probabilities for osteoporotic fractures above which pharmacologic interventions become cost-effective have been determined in several countries. The National Osteoporosis Foundation's cost-effectiveness analysis based on a 35% fracture reduction with treatment and a US $600 per year medication cost assigned high-risk designations to thresholds equal to or above 3% for hip fractures and 20% for any 1 of 4 other major osteoporotic fractures *(9)*. However, although cost-effectiveness is important at a health systems and population-based level for wise allocation of financial resources and to determine appropriate groups to target treatment at, it is not the main factor in making individual clinical decisions nor the primary tool used by physicians when counselling patients.

At an individual level, having a realistic estimate of fracture risk is helpful in explaining the severity of the disease to patients who may be reluctant to start treatment for their osteoporosis because of concern about long-term side effects of medications. On the other hand, reassuring a person who is at low absolute risk of having a fracture is important to avoid overtreatment. Thus, using fracture risk estimation in clinical practice facilitates treatment of patients at high absolute risk of fracture and reassurance of those at low risk. It gives the physician and the patient, through a process of shared decision-making, the chance to make informed treatment decisions.

What to Do Fracture Risk Estimation With

BMD

Osteoporosis is by far the most common metabolic bone disease and it has been variably defined over the last 30 years. From the time when the US National Institutes of Health in 1984 defined it as an "age related disorder characterized by decreased bone mass and by increased susceptibility to fracture in the absence of other recognizable causes of bone loss" *(10)*, subsequent operational definitions have continued to emphasize the concepts of bone density, bone quality, and strength in characterizing this systemic disorder *(11)*. Osteoporosis was defined by the World Health Organization (WHO) as a BMD 2.5 standard deviations or more below the average value for premenopausal women, normal BMD as T-score of −1 or higher, and a T-score between −1.0 and −2.5 was defined as osteopenia *(12)*.

BMD measured using a variety of technologies can be used to predict fractures. Traditionally, diagnosing osteoporosis and estimating fracture risk has been done by measurement of BMD by dual-energy X-ray absorptiometry (DXA). Decreasing BMD is as strong a predictor of fracture risk as blood pressure is of stroke *(13)*. Fracture risk increases with decreasing BMD *(14)*. BMD measured by DXA of the hip and spine is also a predictor of fracture risk reduction in patients treated with several agents such as bisphosphonates *(15)*, strontium ranelate *(16)*, denosumab *(17)*, and teriparatide *(18)*.

Spinal trabecular BMD with quantitative computed tomography (QCT) has the same ability to predict vertebral fractures as lumbar spine BMD by central DXA for postmenopausal women *(19)*. It has to be remembered, however, that the WHO criteria for diagnosis of osteoporosis cannot be applied to T-scores derived from QCT, because fracture risk estimation by QCT was not considered by the WHO study group when evaluating available methods for the assessment of fracture risk *(12)*. At the present time, the role of QCT is primarily in clinical research to evaluate differential effects of therapy on cortical and trabecular bone, although a DXA equivalent BMD of the proximal femur obtained by QCT can be used for diagnosis and with the use of a WHO fracture risk assessment tool, FRAX *(20)*.

Quantitative ultrasound (QUS) of the calcaneus has been shown to predict hip, vertebral, and global fracture risk in postmenopausal women, and hip and nonvertebral fracture risk in men older than 65 years *(21)*. However, QUS T-score values at the calcaneus are not equivalent to those measured by DXA at the hip or spine because of differences in technology, skeletal site, reference databases, and other device-specific factors. A calcaneus QUS T-score is commonly higher than a central DXA T-score and could give the patient or uninformed clinician the false impression that bone strength is better than it really is. Calcaneal QUS also has lower precision than axial DXA and is