Osteoporosis and Imaging: The Big Picture

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ABSTRACT: **The incidence of osteoporosis and osteoporotic-related fractures continues to increase with the aging population. Early diagnosis of low bone mineral density with dual-energy absorptiometry (DXA) and appropriate treatment can prevent fractures. Accurate DXA imaging and patient education regarding the importance of DXA screening play a critical role in patient management. Recognition of osteoporotic fractures on X-ray at the time of an injury or incidentally during imaging for other indications can lead to early treatment and prevention of future fractures. Radiology nurses and other providers are strategically positioned to impact patient outcomes. An overview of osteoporosis, diagnosis, screening guidelines, and nuances of DXA imaging are provided. Case studies provide the clinician with a summary and application of content. (J Radiol Nurs 2016;35:97-110.)**

KEYWORDS: **Osteoporosis; DXA scan; Osteoporosis screening; Risk assessment; Fragility fractures; Imaging; Women's health.**

OSTEOPOROSIS OVERVIEW

Osteoporosis is defined as a condition of low bone mass and microarchitectural disruption that results in fractures with minimal trauma (Cosman et al., 2014). This microarchitectural deterioration occurs in both cortical and trabecular bone and is influenced primarily by the decrease in circulating estrogen and testosterone that occurs with aging (Bousson et al., 2004; Hildebrand, Laib, Muller, Dequeker, & Ruegsegger, 1999). It was estimated that 10.3 million Americans aged 65 years and older have osteoporosis, and an additional 43.1 million have low bone mass (Wright et al., 2014). Of the estimated 10 million Americans with osteoporosis, about eight million or 80% are women (National Osteoporosis Foundation, 2015). In the United States alone, it is estimated that two million fractures per year may be attributed to osteoporosis (Office of Surgeon General, 2004); globally approximately nine million osteoporotic fractures occurred in 2000 with the number rising along with the world's aging population (Johnell & Kanis, 2006). Thus, osteoporosis indirectly presents a significant public health burden, taking a toll on quality of life and imposing a tremendous economic impact.

Risk factors for osteoporosis include nonmodifiable factors such as advancing age (>50 years), sex (female), race (Caucasian and Asian), family history of osteoporosis, and parental history of a fracture. Modifiable risks include current smoking, excessive alcohol intake, and lower levels of physical activity that may be due to lifestyle choices or physical impairment (Seeman, Young, Szmukler, Tsalamandris, & Hopper, 1993).

Fracture Facts

Osteoporotic fractures are most likely located in the thoracic or lumbosacral spine, distal radius, hip region, and proximal humerus but may occur at other sites. Also referred to as fragility or insufficiency fractures, they result from low trauma or may occur spontaneously in the absence of trauma. If associated with a fall, the fall is usually from standing height or less (Cosman et al., 2014).

Morbidity and loss of functional independence frequently result from osteoporotic fractures, in some cases in the immediate postacute setting and in others

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occurring over the course of many years. During the first year after hip fracture, excess mortality risk has been estimated to be 8.4%-36%, with relative risk of mortality at least double that of age-matched controls. Multiple studies demonstrated that mortality risk is higher for men than that for women regardless of age (Abrahamsen, Van Staa, Ariely, Olson, & Cooper, 2009). Previous spine and distal radius fractures (or Colles fractures) increase the risk of subsequent hip fractures by 53%-254% (Haentjens et al., 2003). Figure 1 shows a distal radius fracture, frequently seen in postmenopausal women. Vertebral deformities directly cause restrictive lung disease, constipation, chronic pain, and depression which decreases mobility and independence and ultimately result in the loss of quality-adjusted life years (QALYs; Johnell & Kanis, 2006; Lewiecki & Laster, 2006). A QALY places a weight on time in different health states. The computation uses predicted life expectance and measures of quality of the remaining life years. QALYs provide a "common currency" to assess the extent of the benefits gained from health care interventions related to the quality of life and survival for the patient (Bravo & Vergel, 2008). Twenty percent of hip fracture patients require long-term nursing care after hospital discharge with only 40% of all hip fracture patients recovering their premorbid level of functioning (Office of the Surgeon General, 2004). Ambulatory older adults residing in nursing homes before hospital admission for hip fracture tend to have less recovery of function and lower health-related quality of life (Beaupre, Jones, Johnston, Wilson, & Majumdar, 2012).

Based on a survey of Medicare beneficiaries in 2002, the annual cost of treatment for fractures related to osteoporosis and low bone mass was estimated at $14 billion. At that time, the cost of medications for prevention of fracture was estimated at $2 billion with half of the nonfracture population receiving treatment (Blume & Curtis, 2011). The total projected annual cost by 2025 is $25 billion. This estimate does not take into account indirect costs to society (loss of productivity and quality of life).

Bone Mineral Density Over the Lifespan

Peak bone mass is reached by the mid-20s in women, typically by age 20 years for men. Bone mass then remains stable until the late-20s to early-30s (Heaney et al., 2000). Diet, physical activity, and reproductive hormones each play a key role in optimizing peak bone mass, which provides physiologic reserve for future loss. Estrogen reduces bone turnover via receptors in bone, promotes calcium absorption in the gut,

Figure 1. Colles Fracture. An X-ray image of a fractured radius showing the characteristic Colles fracture with displacement and angulation of the distal end of the radius. Retrieved from https://commons.wikimedia.org/wiki/File%3AColles_fracture.JPG.