Osteoporosis

What is osteoporosis?

Bone is a living tissue that is constantly being broken down and rebuilt. When the balance between breakdown and rebuilding is disturbed - for example, by hormonal changes or dietary changes - the bone may lose some of the minerals that contribute to its density and strength. A condition of diminished bone density is called osteopenia. When a significant loss in bone density occurs, such that the bone is markedly weakened and susceptible to fracture, the condition is termed osteoporosis (porous bone).

Osteoporosis increases the risk of bone fractures, especially in the hips, spine, and wrists. Although it can affect anyone, the risk of developing osteoporosis increases with age, affects women significantly more often than men, and is most prevalent in Caucasian and Asian women. According to the National Osteoporosis Foundation (NOF), 10 million people in the United States have osteoporosis and another 34 million have low bone mass and are at risk of developing the disease. Of those who have osteoporosis, 80% are women.

Most of the people at risk for osteoporosis are not aware of it. It is called a "silent disease" because there are usually no symptoms until a person has a bone fracture. This breakage, frequently in the hip, the vertebrae of the spine, or in the wrist, can occur with very little pressure and can cause the person significant pain and protracted or permanent disability. If the fracture causes severe debility and affects the patient's general health, it may be a contributing factor in the death of the patient.

Bones are primarily a combination of type-I collagen protein and calcium phosphate. The protein forms a spongy network that is "mineralized" by the addition of the calcium compound to make the bones both strong and flexible. Bone is living tissue that is slowly but continuously replaced. During a process called bone resorption, cells called osteoclasts dissolve bone on a microscopic scale and enzymes break down the collagen network. This is followed by the formation of new bone by cells called osteoblasts, which secrete osteocalcin and precursors to collagen and create a new protein framework. The framework is then mineralized to create new bone. This on-going process is called bone turnover or bone remodeling and it takes place throughout the body, normally replacing about 8-10% of the body's bone each year.

During childhood, bone formation proceeds at a faster rate than bone resorption, and bone mass increases to peak at about 30 years of age. After this peak, bone formation slows and resorption begins to outpace it, resulting in a decline in bone mass with age. An inadequate intake of calcium and vitamin D during childhood, the use of medications that contain steroids (such as asthma medications), anorexia, inactivity, smoking, and excess alcohol consumption can all increase the risk of a person developing osteoporosis later in life. Some diseases, such as thyroid disease, Cushing's disease, rheumatoid arthritis, kidney disease, hyperparathyroidism, and vitamin D deficiency can also have an effect on bone health. Those with a strong family history of osteoporosis may also be at an increased risk of developing it themselves.

Menopausal and postmenopausal women may experience an increased rate of bone mass loss with a decrease in estrogen. Going through menopause early can exacerbate the loss. According to the NOF, some women can lose up to 20% of their bone mass in the first 5 to 7 years following menopause. Men with decreased testosterone levels are also at risk for increased bone loss.

There are two types of osteoporosis:

Primary- or age-related osteoporosis. This refers to osteoporosis developing without any apparent cause. It is much more common in women but can also be seen in men, particularly in older men. As mentioned earlier, in some women the rate of bone loss is very high right after menopause, and fractures can occur at a relatively early age, but in most women osteoporosis does not cause fractures until they are in their 60's or 70's. Changes in lifestyle, calcium, or vitamin D supplements or other medications that decrease bone loss may slow the progression of this type of osteoporosis.

Secondary-osteoporosis. This refers to bone loss due to another disease. It affects both men and women and may be due to several different disorders including rheumatoid arthritis, hyperparathyroidism, Cushing's disease, chronic kidney disease, multiple myeloma, or drugs such as anti-epileptics, glucocorticoids, or lithium. Treatment of the underlying disease or cause may slow the loss of bone density in secondary osteoporosis.

Tests

The goals with testing are to determine whether a person has osteoporosis, has low bone mass and an increased risk of developing the disease, is menopausal and/or hormone-deficient, and/or has an underlying condition that may be causing or exacerbating bone loss. Testing may be done to screen for bone density loss or to evaluate bone status when a person has an unexpected bone fracture and may be used to monitor osteoporosis therapy for effectiveness. Diagnostic imaging, a non-laboratory test, is used in the Bone Mineral Density test, the primary screening and diagnostic test for osteoporosis.

Non-Laboratory Tests

The bone mineral density (BMD) test is the primary test used to identify osteoporosis and low bone mass. One of the preferred and most accurate ways to measure BMD is Dexa-Scan (dual-energy X-ray absorptiometry or DXA). It uses a low energy X-ray to evaluate bone density in the hip and/or spine. BMD is often reported in terms of peak bone mass in young adults. A BMD value that is less than 1 standard deviation below the young adult mean is considered normal. BMD in osteopenia has a value between -1 and -2.5 standard deviations below the young adult mean while osteoporosis BMD values are even lower and are at least -2.5 standard deviations below the mean.

Several organizations have published recommendations on screening for osteoporosis, including the U.S. Preventive Services Task Force, which recommends using DXA to screen all women 65 years and older and women 60 to 64 years of age who are at increased risk for fractures. The National Osteoporosis Foundation (NOF) recommends screening men over 70, women over 65, and adults who are middle aged and at risk.

Your health care provider can now also use a calculator, called the FRAX tool, to better determine your risk of a hip, wrist, shoulder, or spine fracture after age 40. Available online or on paper, the calculator, developed by the World Health Organization, considers the bone density measurement and 9 other risk factors. It is an algorithm on absolute fracture risk. The NOF has adapted this algorithm for the US and its Clinician's Guide released in February 2008 applies it.

Portable BMD screening devices, utilized at some pharmacies, health fairs, etc., are used to scan people's heels or fingers. These scans are not as accurate as the DXA but may be used as an initial scan. When these tests show decreased bone density, a DXA scan may be performed for confirmation.

Other diagnostic imaging tests that may be done to measure BMD and to detect osteoporosis include CT scans (computerized tomography), X-rays, and ultrasounds. A general screening test called "body composition analysis" can determine a person's percentages of body weight due to muscle, fat, bone, and water. There are a few different ways to measure body composition including the use of specialized instruments. If body composition analysis is performed and results tracked from year to year, it may be able to help detect bone loss.

One other diagnostic imaging test used to evaluate the condition of the bones is a bone scan, which is not to be confused with the bone density scan or BMD. While the BMD test is used to identify low bone density that is indicative of osteoporosis and is non-invasive, a bone scan is a nuclear medicine test used to rule out other serious conditions of the bones. To perform this test, a radioactive tracer is injected into a vein in the arm. The tracer then travels through the blood and is absorbed by the bones. The level of radioactivity detected in the bone is evaluated and can point to conditions or diseases such as metastatic cancer, infection, causes of unexplained bone pain, or Paget's disease. This type of scan can discover problems with the bones much earlier than a regular X-ray and may be ordered when patients have a high frequency of bone fractures.

Laboratory Tests

Blood tests may include:

- Blood calcium levels - this test is usually normal in osteoporosis but may be elevated with other bone diseases
- Vitamin D - deficiencies can lead to decreased calcium absorption
- Thyroid tests - such as T4 and TSH to screen for thyroid disease
- Parathyroid hormone (PTH) - to check for hyperparathyroidism
- Follicle-stimulating hormone (FSH) - to check for menopause
- Testosterone - to check for deficiency in men
- Protein electrophoresis - to identify abnormal proteins produced by a certain type of cancer (called multiple myeloma) that can break down bone

- Alkaline phosphatase (ALP) - to test for increased levels that may point to a problem with the bones.

Bone markers are blood and urine tests that may sometimes be ordered to help evaluate and monitor the rate of bone resorption and formation.

Tests measuring bone loss

Bone resorption tests tell about the rate of bone loss. They can be checked before treatment and again after treatment to see if the rate of bone loss has decreased. They include:

- C-telopeptide (C-terminal telopeptide of type 1 collagen (CTx))
- Deoxypyridinoline (DPD)
- Pyridinium Crosslinks
- Tartrate-resistant acid phosphatase (TRAP) 5b

Tests measuring bone formation

Bone formation tests tell about the rate of bone production. As with bone turnover tests, they may be checked before the start of treatment and periodically after treatment to see if bone formation has increased. They include:

- Bone-specific alkaline phosphatase (ALP)
- Osteocalcin (bone gla protein)
- P1NP (Procollagen Type 1 N-Terminal Propeptide)