Definition, diagnosis and causes of Osteoporosis

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Osteoporosis comes from 'osteo' meaning bone and the greek word por (passage) ie simply it means porous bone.

Normal bone is composed of a mixture of calcium and other minerals such as magnesium and phosphate. It is also made up of collagen (protein), which forms the structural framework of bone.

Osteoporosis occurs when there is a loss of mineral from bone mainly in the form of calcium as well as architectural loss of normal bone structure. The loss of mineral content of the bone is referred to as a loss of **bone mineral density** in the bone.

Normal bone

Osteoporotic bone: one can see thinning of connecting bone and big spaces in the bone structure making the bone more fragile

Osteoporosis results in loss of bone strength, thus making bone more fragile and easily susceptible to fracture.

It is a process that affects all individuals and is a part of normal aging. All individuals if they live long enough will develop osteoporosis. Some individuals due to various illnesses or as part of hormone deficiency states will develop osteoporosis at an earlier stage in their life. After menopause women are at an increased risk of osteoporosis.

In itself, osteoporosis causes no symptoms. It is when fractures occur that the problems of osteoporosis arise.

Diagnosis of Osteoporosis

In past years osteoporosis was diagnosed by plain X ray which may have shown bone tissue to be less dense on X ray or the presence of crush fractures.

Today the diagnosis of osteoporosis is guided by measurement of the amount of mineral in bone (mainly calcium) by a special X ray technique called a Dual Energy X ray Absorptiometry scan (DEXA scan)–see below. When osteoporosis is indicated by DEXA the diagnosis really relies on an increased risk of having a future fracture determined by a mathematical formula rather than a disease diagnosis.

This is important as over 50 per cent of older women who in fact have an osteoporotic fracture seen on plain X ray in fact have normal bone density on DEXA Scan (Greenspan S et al, J Clin Densitom 2001; Davis SR et al Menopause 2010).

> Therefore, screening older women (over 70 years of age) for osteoporosis requires a plain X ray of the spine to identify fractures, ideally combined with a DEXA scan.

Osteopenia is diagnosed when there is reduced mineral content in bone, but not as low as to be considered osteoporosis.

DEXA

A Dual Energy X ray Absorptiometry scan (DEXA scan) is a specialised X ray technique, which specifically measures bone mineral density (bone mineral content) and provides the most accurate way currently available to diagnose osteoporosis.
It is a specialised X ray and is not painful.

It is used:

- To confirm the diagnosis of osteoporosis.
- To estimate severity of bone loss.
- To determine whether the patient is responding to treatment.

It is a fast scan, has high resolution, is easily reproducible and has lower radiation dose compared to other methods.

Usually only the lumbar spine (lower back) and proximal femur (hip region) are measured.

Understanding Your DEXA Study Result

Your DEXA result will be reported as a T score. T scores are complicated statistical scores, that help define on DEXA study the condition of an individual's bones. When a DEXA study is performed, the bone mineral density is measured and compared to the bone mineral density of twenty year olds of the same sex. Twenty year-olds are used for comparison as they have the greatest peak bone mass.

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A T score which is positive or only minus one standard deviation (up to one step below normal) from the normal bone mineral density of a 20 year old is regarded as being a normal bone mineral density, for the site that it is measured at.

If the T Score is minus 1.0 to minus 2.5 standard deviations (between 1 and 2½ steps) below the normal bone mineral density of a 20 year old, this indicates the presence of osteopaenia. Osteopaenia is not osteoporosis. It represents a stage when the bones have lost some bone mineral strength and are weaker, but not as weak as in osteoporosis. It can be regarded as the phase before the occurrence of osteoporosis.

If the T score is greater than minus 2.5 standard deviations (greater than 2½ steps) below the normal bone mineral density of a 20 year old, this indicates the presence of osteoporosis

Dexa Bmd Values	Definition
T score > -1.0 S.D	Normal bone mineral density
T score between -1.0 and -2.5 SD	Osteopenia
T score ≤ - 2.5 SD	Osteoporosis
T score ≤ - 2.5 SD with 1 or more fragility fractures	Severe osteoporosis

(WHO Working Group Definition of Osteoporosis)[25]

- Bone density of the hip measured by DEXA provides the most reliable risk prediction for future fracture.

How common is osteoporosis?

- After the age of 60 years, one in two Australian women and one in three Australian men will sustain an osteoporotic fracture.
- Of all osteoporotic fractures in Australia, 46 per cent are vertebral fractures, 16 per cent are hip fractures and 16 per cent are wrist fractures.
- Hip fractures are particularly problematic as there is evidence to suggest that 50 per cent of elderly patients sustaining a hip fracture need subsequent long-term nursing care.
- There also is an increased risk of mortality associated with hip fractures with some figures indicating that 15 per cent of hip fractures in the elderly lead to death within four months of the fracture.[1]

Causes of Osteoporosis

During childhood and adolescence, the bones within the skeleton are actively growing. By one's early 20's, growth and development of bone is complete. This phase of bone development represents the attainment of "peak bone mass". It essentially is a time when bones are at their 'strongest'.

The peak bone mass that is achieved varies from one individual to the next and primarily reflects what has occurred during growth and development in childhood and adolescence. It is also influenced by genetic factors as well. Hence an individual who has had adequate intake of vitamin D, calcium, plenty of exercise and not been subjected to any sex hormone deficiencies (e.g. interruption to menstrual periods) during childhood and puberty will likely achieve a high peak bone mass as compared to the individual who has not had favourable circumstances for bone development during childhood and adolescence.

Normal ageing lead to a gradual loss of bone mineral density, usually over several decades, often starting from the late 30's. The higher the peak bone mass that is achieved by the early 20's, then the greater the likelihood of withstanding the effects of normal age related bone loss. Individuals with a low peak bone mass, may not withstand the effects of age related bone loss as well as those who have achieved a high peak bone mass and hence may develop osteoporosis at a younger age.

Certain medical illnesses also effect bone and can lead to the development of osteoporosis, often independent of peak bone mass.

Below is a list of medical conditions which have been associated with the development of osteoporosis.

Causes of Osteoporosis
Failure to attain adequate peak bone mass in early 20's
Chronic illness e.g chronic liver disease, chronic renal failure
Thyroid disease, particularly hyperthyroidism or excessive thyroxine replacement
Smoking
Sedentary lifestyle
Excessive caffeine intake (> 5 – 6 cups/day)
Excessive alcohol intake
Lifelong low calcium intake
Increasing age
Genetic factors and Ethnic factors (Caucasian and Asians)
Hormone deficiency states (late menarche, premature menopause, menopausal state, testosterone deficiency in males)
Vitamin D deficiency
Primary hyperparathyroidism
Prolonged immobilisation
Cushing's syndrome or disease
Corticosteroid therapy (doses of prednisolone > 5 – 7.5 mg daily or an equivalent dose of another glucocorticoid for greater than 2 months; any dose of glucocorticoid in the elderly > 65 yrs)
Malabsorptive illnesses eg Coeliac disease, Crohn's disease
Eating disorders (Anorexia nervosa, Bulimia)
Rheumatoid arthritis
Organ transplant recipients
Treatments for certain malignancies e.g breast cancer, prostate cancer