# Osteoporosis for the Orthopaedic Resident

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## What is osteoporosis?

Osteoporosis is a systemic skeletal disease characterised by low bone mass and architectural deterioration of bone tissue resulting in increased bone fragility. It can be defined:

- **Clinically as a minimal trauma fracture (particularly at the hip or vertebra), OR**
- **Objectively as a bone mineral density 2.5 or more standard deviations (SD) below normal peak bone mass (T score $\leq$ -2.5)**

The risk of developing osteoporosis is related to a person's bone development and maintenance over their life span. By the age of 20-30 years old, bone mass has reached its peak as influenced by factors such as genetics, diet, calcium intake and exercise levels. Over approximately the next 20 years, bone mass is maintained through equal rates of bone reabsorption and deposition. However, after the age of 40-50, the rate of bone reabsorption accelerates markedly, thereby increasing the risk of developing osteoporosis (1). This is particularly true in post-menopausal females whose diminishing oestrogen levels make them the most vulnerable cohort to osteoporotic fractures (2).

## Why is osteoporosis so important to manage?

Fractures are associated with significant pain, disability and a poor quality of life (1). Hip fractures carry the most significant burden to the individual and the healthcare system. Hip fractures have been consistently associated with an increased mortality, with the risk of death being greatest acutely following the fracture. Elderly and institutionalised patients appear to be the most vulnerable cohort to hip fractures, demonstrating up to 30% excess mortality (3). Hip fractures are also associated with a loss of independent mobility, increased assistance with activities of daily living and institutionalisation (4). Vertebral fractures have been associated with increased mortality, chronic back pain, kyphosis and loss of self-esteem (2).

With an ageing population, there is an increased number of Australians who are at risk of developing osteoporosis and subsequent fragility fractures. Therefore, there is a strong public health argument to promote bone health to minimise future fracture-related morbidity, mortality and costs (5). The Orthopaedic team is in a unique position to be able to identify, investigate and potentially treat a large subset of patients presenting with new osteoporosis in the form of a fragility fracture. This is often undertaken in conjunction with the Orthogeriatrics team.

## What are the risk factors for osteoporosis?

The biggest risk factor for osteoporosis is increasing age. However, consider the following other risk factors in the work-up and management of osteoporosis (6):

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| Non-modifiable | ◦ Ageing<br>◦ Family history of osteoporosis |
| Lifestyle or modifiable | ◦ Early menopause<br>◦ Hypogonadism<br>◦ Low body weight<br>◦ Low muscle mass and strength<br>◦ Malnutrition<br>◦ Immobility<br>◦ Excessive alcohol intake<br>◦ Smoking<br>◦ Vitamin D deficiency<br>◦ Protein and calcium deficiency |
| Chronic disease | ◦ Rheumatoid arthritis<br>◦ Hyperthyroidism<br>◦ Hyperparathyroidism<br>◦ Chronic kidney disease<br>◦ Chronic liver disease<br>◦ Coeliac disease/malabsorption<br>◦ Diabetes mellitus<br>◦ Myeloma/monoclonal gammopathy of unknown significance (MGUS)<br>◦ Organ transplant/bone marrow transplant<br>◦ HIV infection<br>◦ Depression |
| Medications | |

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| | ◦ Glucocorticoids<br>◦ Excess thyroid hormone replacement<br>◦ Aromatase inhibitors<br>◦ Anti-androgen therapy |

## How does it present?

Osteoporosis is a silent disease until a symptomatic fracture occurs. The most common osteoporotic fracture sites include the vertebrae, distal radius, surgical neck of humerus and neck of femur (hip). However, because of its systemic nature, large prospective studies have demonstrated that almost all types of fractures are associated with a low bone mineral density (BMD) (4).

## What investigations should you consider?

When a patient above the age of 65 years presents to the Orthopaedic ward with any of these fractures, it is of utmost importance that we consider their bone health. The following tests should be considered and interpreted in consultation with Orthogeriatrics or Endocrinology (depending on the services available to you):

- **Full blood count, electrolytes/urea/creatinine, liver function tests**
- **Calcium, phosphate, vitamin D and parathyroid hormone**
- **Thyroid function tests**
- **Serum protein electrophoresis, serum and urinary free light chains/Bence Jones protein**

In addition, if there is a high clinical suspicion of secondary osteoporosis (e.g. multiple fragility fractures in a younger individual) you may be requested to order the following:

- **Coeliac screen**
- **Hba1c**
- **Oestrogen, LH and FSH**
- **Serum testosterone**
- **Hypercortisolism screen**
- **24-hour urinary calcium and creatinine excretion**

A dual energy x-ray absorptiometry (DEXA) is considered the gold standard measure of bone quality. However, in Australia, a DEXA is not required to diagnose and treat someone for osteoporosis if they present with a minimal trauma hip or vertebral crush fracture. You will recall that the DEXA can be interpreted as:

- **T score: Number of standard deviations (SD) of BMD at any major skeletal site that deviates from a young adult mean of the same sex.**
    - **T $\leq$ -2.5 = Osteoporosis**
    - **T < -1 but > -2.5 = Osteopenia**
    - **T $\geq$ -1 = Normal**
- **Z score: Number of SD of BMD at any major skeletal site that deviates from an age- and sex-matched individual.**
    - **Z score < -2 = Abnormal bone loss (look for secondary causes).**

## How do we manage osteoporosis?

Non-pharmacological measures include the following:

- **Optimise conditions associated with secondary osteoporosis.**
- **Falls prevention.**
- **Smoking cessation.**
- **Reduce alcohol intake to $\leq$2 standard drinks/day.**
- **Adequate nutritional intake and maintenance of ideal body weight.**
- **Increased weight-bearing physical activity.**
- **Adequate calcium and vitamin D intake.**

Vitamin D replacement has not been associated with a reduced risk of fragility fractures (7). However, it is important to ensure vitamin D levels are >50nmol/L to minimise the risk of hypocalcaemia associated with antiresorptive therapy.

Most of the daily recommended intake of calcium can be consumed through calcium-rich foods. However, one would consider oral calcium replacement to minimise the risk of hypocalcaemia associated with antiresorptive therapy (especially denosumab).

## Antiresorptive therapy

The cornerstone of osteoporosis treatment is antiresorptive therapy in the form of bisphosphonates or denosumab. Antiresorptive therapy reduces the risk of vertebral and hip fractures by 40-70% and non-vertebral fractures by 20-30% (6). It is a common misnomer that antiresorptive therapy impairs fracture healing. This is not true (8)! Therefore, an active effort

must be made to consider antiresorptive therapy during an inpatient admission for minimal trauma hip or vertebral crush fractures.

Limitations to immediately commencing antiresorptive therapy may include if the patient is not dentally fit or vitamin D/calcium replete. In these cases, ensure an adequate handover is completed to the patient's General Practitioner or rehabilitation services to minimise the risk of treatment being overlooked in the community.

Here is a brief overview of these medications:

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| Bisphosphonates | ◦ Options: Alendronate (oral), risedronate (oral), zoledronic acid (intravenous (IV))<br>◦ Oral bisphosphonates can be given weekly or monthly<br>◦ IV zoledronic acid can be given yearly or 18-monthly<br>◦ Ensure the patient is dentally fit, vitamin D replete (>50nmol/L) and calcium replete prior to treatment<br>◦ Contraindicated if creatinine clearance (CrCl) <30-35ml/min<br>◦ Adverse effects:<br>  ◦ Oesophagitis/gastritis (oral)<br>  ◦ Flu-like illness (IV)<br>  ◦ Osteonecrosis of the jaw<br>  ◦ Atypical femoral fractures<br>◦ A "drug holiday" can be considered after a certain period of treatment following consultation with Endocrinology |
| Denosumab | ◦ Given as a 6 monthly subcutaneous injection<br>◦ Ensure the patient is dentally fit, vitamin D replete (>50nmol/L) and calcium replete prior to treatment<br>◦ Take caution if CrCl <30ml/min as there is an increased risk of hypocalcaemia (may require more frequent calcium monitoring and vigorous calcium supplementation)<br>◦ Adverse effects:<br>  ◦ Hypocalcaemia<br>  ◦ Osteonecrosis of the jaw<br>  ◦ Atypical femoral fractures<br>◦ Withdrawal of denosumab is associated with multiple spontaneous vertebral fractures so DO NOT stop or delay a dose by more than 4 weeks<br>◦ In the majority of cases, treatment is continued indefinitely, but if considering ceasing denosumab, the patient must be transitioned to a bisphosphonate first |

Selective oestrogen receptor modulators are only associated with a reduced risk of vertebral fractures and are reserved for those with spinal osteoporosis and a past or family history of breast cancer.

Treatment failure is defined as the occurrence of ≥2 fragility fractures whilst on antiresorptive therapy for greater than 12 months (6). Teriparatide may be considered by the Endocrinology team in the setting of severe osteoporosis and failed antiresorptive therapy.

## Take-home messages

- The Orthopaedic team is in a unique position to be able to identify, investigate and potentially treat a large subset of patients presenting with new osteoporosis in the form of a fragility fracture.
- A minimal trauma hip fracture is clinically diagnostic of osteoporosis.
- Also consider the diagnosis of osteoporosis in those presenting with minimal trauma vertebral, humerus and distal radius fractures.
- Antiresorptive therapy does not affect fracture healing and can be started immediately if the patient is dentally fit and vitamin D/calcium replete.
- Withdrawal of denosumab is associated with multiple spontaneous vertebral fractures so DO NOT stop or delay the dose by more than 4 weeks.
- Seek Renal advice for osteoporosis treatment in chronic kidney disease (where treatment is decided on a case by case basis).

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**Tags:** #ageing,#antiresorptive therapy,#Bisphophonates,#BMD,#bone fragility,#bone mineral density ,#Denosumab,#DEXA,#endocrinology,#fragility fractures,#hip fractures,#low bone mass,#minimal tra uma fracture,#ortho,#orthogeriatrics,#orthopaedic,#osteoporosis,#skeletal disease