Prevent the next fracture

Health Professional Guide

osteoporosis australia
Healthcare professionals play an important role in the prevention and management of osteoporosis and should be aware of those people who are at high risk of fractures whom they can readily identify. Osteoporosis is often undiagnosed and untreated even after a fracture has occurred and come to medical attention. Healthcare professionals should be aware of those people at high risk of fractures, and are well placed to help identify and effectively manage such patients.

Osteoporosis is characterised by low bone mass and poor bone quality. This leads to an increased risk of fracture, and can cause significant disability. The incidence is rising around the world as the population ages: up to 2 million Australians are affected by osteoporosis, with more than 70,000 osteoporotic fractures per year. It is estimated that by 2021, these rates will more than double.

Vertebral fractures are the most common osteoporotic or fragility fracture. Of these, more than half of all vertebral fractures do not come to medical attention (although nearly all will be associated with disability and pain). Approximately half of all patients with a fracture due to osteoporosis will go on to have another: the so called ‘cascade effect’. Women who have suffered a vertebral fracture are 4 times more likely to sustain a new fracture within the next year. They are at increased risk of hip fracture with all of its associated costs, and increased risk of premature death.

Of concern is that more than 75% of people with osteoporotic fractures who come to medical attention are NOT treated to prevent further bone loss and stop the ‘cascade’ effect of further fractures. (International Osteoporosis Foundation)

This booklet aims to facilitate optimal management of osteoporosis by helping healthcare professionals to identify patients at risk of the disease, recommend appropriate management measures such as physical activity and nutrition programs, and refer when necessary. The goals of management are to minimise the risk of first fractures and prevent the cascade effect of further fragility fractures.

This guide is based on a review of current evidence and research. A bibliography and reference list for this guide is available at www.osteoporosis.org.au.
1. BONE LOSS AND FRAGILITY

- Bone is divided into cancellous (or trabecular) bone and cortical bone. Cancellous bone, which is more metabolically active, is formed by an interconnecting latticework and is surrounded by the less delicate cortical bone.

- Bone is remodelled (bone turnover) throughout adult life by discrete remodelling units of osteoclasts (cells that resorb a volume of bone) and osteoblasts (cells that lay down new bone matrix).

- After about the age of 50 years, the volume of bone resorbed is greater than the volume formed in each bone remodelling unit. This process is accelerated during menopause and continues in old age (i.e. over 70 years of age).

- During menopause, the decrease in oestrogen enhances the rate of bone dissolution, and most women begin a period of accelerated bone loss, averaging 2-5% per year over the next 10 years.

- Accelerated bone loss is greatest in the first three to six years after menopause and then gradually resumes the level of premenopausal bone loss. After the age of 70, bone loss begins to accelerate again, reaching 1-2% per year in women older than 80 years.

- A 10% loss of bone mass in the vertebrae can double the risk of vertebral fractures, and a 10% loss of bone mass in the hip can result in a 2.5 times greater risk of hip fracture.

- Men do not have a midlife increase in remodelling, so that structural integrity of trabecular bone is maintained for longer.

- Fracture risk increases exponentially for men and women, so the imperative to intervene pharmacologically for those at risk increases with age, particularly for people aged over 70.
2. FRACTURE PATTERNS

- Approximately every 8 minutes someone is admitted to an Australian hospital with an osteoporotic fracture (an average of 177 hospitalisations per day in 2001-2002).
- 30-50% of Australian women and 15-30% of men will develop osteoporotic fractures.
- Osteoporotic fractures commonly occur in the hip, spine, humerus, ribs, forearm or wrist, often with little or no trauma (although almost any bone can fracture from osteoporosis).
- Wrist fractures are the most common fracture in perimenopausal women and increase rapidly after menopause.
- Fragility or minimal trauma fractures are the result of trauma equal to or less than a fall from standing height. Fragility fractures of upper limbs are typically due to falls.
- The risk of falling per annum increases from 1 in 5 in women aged 45-49 years to almost 1 in 2 in women aged 85 years and older. The risk of falling in older men is 1 in 3 per annum.
- Vertebral fractures tend to occur when the person is lifting a weight or being lifted, or even during everyday activities like sneezing, turning around quickly, or doing up shoes. Vertebral fractures range from mild wedge compressions to complete crush fractures.
- Osteoporosis prevalence increases with age but health surveys underestimate osteoporosis because most people are unaware of the condition until a symptomatic fracture occurs.
- A fragility fracture in late middle-aged or elderly people suggests a clinical diagnosis of osteoporosis.
- Available therapies can reduce the risk of osteoporotic fractures by approximately 50% within a year of beginning treatment.

![Figure 2: Age-specific prevalence of osteoporosis](image-url)
3. THE FRACTURE CASCADE

- Of all reported osteoporotic fractures, 46% are vertebral, 16% are hip and 16% are wrist fractures.
- Approximately two thirds of all vertebral fractures are asymptomatic but the risk of further fractures is increased 4-fold following the first fracture.
- Women who have had 2 or more osteoporotic fractures have up to a 9 times greater risk of a future fracture compared to those who have not had a fracture. This rises to an 11 times greater risk if 3 or more fractures are present. This ‘fracture cascade’ can eventually result in pain, deformity, disability and even early death.
- However, medical records, X-ray reports and discharge summaries often fail to note osteoporosis in elderly women despite spinal X-rays showing severe vertebral deformities.
- Hip fractures reduce life expectancy. More than 20% of people who suffer a hip fracture (which tend to occur in older populations) die within 12 months, 50% need long-term help with activities of daily living, and 15-25% require full-time nursing-home care.
- About one in every 4 to 5 hip fractures in people aged over 50 occurs in men. By 2023, the number of hip fractures in men is projected to equal the number of hip fractures in women in 1990.
- Men have higher disability and death rates after a hip fracture than women.

Life time fracture risk of people at 50 years of age

One in three women and one in eight men over 50 years of age will experience osteoporotic fractures:

Wrist fracture: men 1 in 40 (2.5%) ; women 1 in 6 (16%)
Vertebral fracture: men 1 in 20 (5%) ; women 1 in 6 (16%)
Hip fracture: men 1 in 17 (6%) ; women 1 in 6 (17.5%)  
(Melton L.J., 1992)

“Based on WHO definitions, about 11% of Australian men and 27% of Australian women aged 60 and over have osteoporosis, and another 42% of men and 51% of women have osteopenia.”  
(International Osteoporosis Foundation)
4. THE HEALTH PROFESSIONAL’S ROLE

Health professionals are well placed to:

• **Help identify patients at risk of osteoporosis**
• **Assist in the prevention and management of osteoporosis by prescribing lifestyle measures to prevent bone loss, falls and fractures**
• **Refer to a general practitioner for appropriate investigations**

A. IDENTIFYING PATIENTS AT RISK OF OSTEOPOROSIS

Healthcare professionals including physiotherapists, occupational therapists, exercise physiologists, dieticians and nurses (community, practice, ER and orthopaedic) have the opportunity to identify a person’s risk of osteoporosis by simply asking some standard questions during a consultation.

Nurses and physiotherapists are often the first point of contact for a patient presenting with pain and/or dysfunction, so it is important to be aware of the risk factors for osteoporosis, recognise when a spinal osteoporotic fracture may have occurred, and refer to the GP for follow-up investigation if concerned. Healthcare professionals also play an important role in the management of the patient with osteoporosis.

There are two main types of osteoporosis:

• **Primary osteoporosis**, which includes postmenopausal and age-related osteoporosis
• **Secondary osteoporosis**, caused by identifiable agents or disease (see Table 1 for common causes of secondary osteoporosis).
RISK FACTORS FOR OSTEOPOROSIS

Genetics
- Maternal family history of osteoporotic fracture
- Caucasian or Asian race

Increasing Age

Previous low trauma fracture (fragility fracture) particularly of the hip, spine or wrist.

Loss of height, thoracic kyphosis (Dowager’s hump)

Hormonal and metabolic factors
- Early menopause, late menarche (women)
- Low testosterone levels (men)
- Hypogonadism
- Anorexia nervosa
- Low body mass index
- Hyperthyroidism
- Absence or suppression of menstrual periods (amenorrhea > 1 year)

Comorbidity and medical treatments
- Corticosteroid therapy (prednisolone, or equivalent, 7.5mg or more daily with an expected use of 3 months or more) is the most common cause of secondary osteoporosis
- Malabsorption syndromes (including chronic liver disease, Coeliac disease and inflammatory bowel disease)
- Chronic renal failure
- Rheumatoid arthritis
- Prolonged bed rest and immobilisation

Lifestyle Factors
- Inadequate dietary calcium intake
- Vitamin D deficiency – much more common than previously recognised
- Physical inactivity/sedentary lifestyle over many years
- Smoking
- Regular, excessive alcohol use – especially in men

Increased risk of falls
- Poor quadriceps strength
- Poor balance
- Poor eyesight
- Use of sedatives/psychotropics
- Polypharmacy
### TABLE 1  COMMON CAUSES OF SECONDARY OSTEOPOROSIS

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### ASSESSMENT AND MEDICAL HISTORY

**IMPORTANT THINGS TO CONSIDER IN YOUR PATIENTS**

**Medical History**

**Musculoskeletal**

- Is the person losing height, i.e. shrinking? Ask if they have lost more than 3cm in height. A loss of more than 3cm in height is a surrogate marker for the presence of vertebral fractures. Ask patients to recall their height in young adulthood, and measure their height as part of every check-up in older patients.
- Do they have back pain? Only one-third of vertebral fractures come to clinical attention as many people believe back pain is a normal part of ageing and will not mention it unless prompted.
- Do they complain of sudden, severe back pain?
- Have they had a recent fall?
- Have they had a recent bone fracture (and are postmenopausal or a male over 60 years)? Forearm fracture is an early and sensitive marker of male skeletal fragility. In comparison to women, ageing men with wrist fractures have a higher absolute risk for hip fracture than spinal fractures. Ask how any injury occurred.
Diagnosis of Osteoporosis

- The diagnosis of osteoporosis is based on the measurement of bone mineral density (BMD) and clinical assessment.
- BMD is expressed in terms of a T-score; this is the number of standard deviations (SDs) from the young and normal mean BMD.
- BMD predicts fracture risk. For every standard deviation (SD) below peak bone mineral density, fracture risk increases by 50-100%.

Nutrition
- Assess diet, in particular daily calcium intake.
- Are they getting enough vitamin D or are they vitamin D deficient? (see Groups most at risk of vitamin D deficiency, page 19)
- What is their daily exposure to sunlight?
- Are there any cultural considerations affecting sun exposure?

Physical Activity
- What is their level of physical activity?

Other medical conditions
- Have they been treated with steroids? Corticosteroid-induced osteoporosis is the most common cause of secondary osteoporosis. See Table 1 for other medications that may decrease BMD.
- Is there any malabsorption syndrome present?
- Is there any other chronic systemic disease?

Alcohol and smoking
- Assess alcohol intake and smoking patterns.

Menstrual history
- Take a menstrual history. Prolonged amenorrhoea and early menopause are important factors to be aware of.

Physical examination
- Has your patient developed a Dowager’s Hump?
- Do they have increased kyphosis? Kyphosis may indicate a previous spinal fracture.
- Do they have any spinal bone tenderness?
- Do they have proximal muscle weakness (may indicate vitamin D deficiency)?
- Are there any signs of neurological impairment or visual impairment? These may increase the risk of falling.
WHO DEFINITIONS BASED ON BONE DENSITY LEVELS*

Normal:
BMD is within +1 or -1 SD of the young adult mean.

Osteopenia (low bone mass):
BMD is between -1 and -2.5 standard deviations below young adult mean.

Osteoporosis:
BMD is -2.5 SD or more from the young adult mean.

Severe (established osteoporosis):
BMD is more than -2.5 SD and one or more osteoporotic fractures have occurred.

* based on DXA measurement at hip or spine

NOTE: For every standard deviation (SD) below peak bone mineral density, fracture risk increases by 50-100%. The same BMD values are provisionally used for men because currently there is little data on BMD and fracture in men.

BMD TESTING – REBATE

A Medicare rebate is now available (from April 1, 2007) for BMD testing (DXA scan) for all women and men aged 70 years and over.
3. THE FRACTURE CASCADE

BONE DENSITOMETRY

- Bone densitometry by dual-energy X-ray absorptiometry (DXA) of hip and spine is the ‘gold standard’ test for diagnosing osteoporosis and monitoring response to treatment.

- The hip (femoral neck, trochanteric, intertrochanteric sites) and lumbar vertebrae (L1-L4 or L2-L4) are used unless there are abnormalities in these regions that may affect bone density.

- Proximal femur BMD appears to be the best overall predictor of fracture risk, particularly as it is unaffected by osteoarthritis. The presence of spinal osteophytes can lead to discrepancies between hip and spine BMD values.

- Suspected degenerative changes in the spine should be confirmed by plain radiograph. In younger patients, a disparity between spinal and proximal hip bone density can suggest secondary osteoporosis, eg. hyperparathyroidism.

- Peripheral DXA and spinal quantitative computed tomography (CT) are sometimes used as alternatives for diagnosis.

- Quantitative ultrasound of the heel (calcaneus) is not currently recommended as an appropriate standard test for BMD and is not reimbursed by Medicare.

- Measurement of BMD should be used as part of patient care for high risk individuals rather than for screening healthy patients, i.e. if the decision to treat a patient will be influenced by the result of the test. A Medicare rebate for DXA (for people aged less than 70 years) is only reimbursed for certain high-risk categories:
  - Confirmation of a presumptive diagnosis of osteoporosis in a patient with one or more minimal trauma fractures; or
  - To check BMD in a patient undergoing prolonged glucocorticoid therapy; a patient with hypogonadism; a patient with primary hyperparathyroidism; conditions associated with excess glucocorticoid secretion; oestrogen deficiency causing amenorrhoea lasting more than six months before the age of 45 years; chronic liver disease; chronic renal disease; proven malabsorptive disorders, especially Coeliac disease; rheumatoid arthritis; or conditions associated with thyroxine excess.

In postmenopausal women, the rate of bone loss is generally 1-2% per annum; hence an interval of 2 years between scans is satisfactory, unless there is an accelerated rate of bone loss, in which case yearly measurements may be required.
RADIOGRAPHY

- Plain X-rays should be ordered to check for asymptomatic spinal fractures in patients with high risk factors or a known loss of height or osteoporosis documented on bone densitometry.
- X-rays should also be considered to check for sudden, severe unexplained back pain, which may indicate a new vertebral or recent fracture.
- Plain X-rays are also useful in investigating a BMD that is higher than expected or where there is a discrepancy between hip and spinal BMD.

OTHER INVESTIGATIONS

- **Blood tests:** usually normal in a patient with osteoporosis. Tests may be indicated to exclude other causes of bone mineral loss such as primary hyperparathyroidism, malabsorption, thyroid disease or vitamin D deficiency.
- **Bone markers:** these measurements may provide additional independent information in assessing fracture risk, but cannot quantify total skeletal bone mass and are not routinely indicated for osteoporosis assessment.

FIGURE 3 VERTEBRAL FRACTURE AS AN INCIDENTAL FINDING

This radiograph was ordered in a 55-year-old woman to assess suspected rib fracture. The radiologist’s report did not mention the wedge fracture visible at T7 (outlines enhanced in image on right).
B. MANAGEMENT OF OSTEOPOROSIS TO PREVENT THE FIRST FRACTURE

“Treatment of established osteoporosis is cost-effective irrespective of age. Therapies with proven rapid efficacy may offer important value to healthcare payers, providers and patients.”  
(International Osteoporosis Foundation)

WHO SHOULD BE TREATED?

- **People with normal BMD**: osteoporosis treatment has not been shown to reduce fracture rates in women with normal BMD or women with osteopenia.
- **Women with osteopenia but no fracture**: it may be reasonable to defer treatment (unless on long-term corticosteroids). Patients should be followed up by their GP within 1-3 years, depending on risk factors.
- **Men with osteopenia**: fracture rates are quite low in these men and, to date, clinical studies have not shown a therapeutic effect with treatment.
- **Women with osteopenia where a spinal fracture is present**: treatment should be considered.
- **Women diagnosed with osteoporosis, with or without fractures**: treatment to prevent fractures and further bone loss is recommended.
- **All women and men with a fragility fracture**: drug treatment to reduce the risk of future fractures should be considered, as the risk of further fractures is increased by 30-40% within three years. Treatment is particularly effective for those people who have already had a fracture.
- **All people on prolonged corticosteroid therapy**: should be given preventative treatment, as it is estimated that 30-50% will experience fractures. Fracture risk is related to the severity of reduction in bone density and the duration of exposure to corticosteroids.
- **Osteoporosis in men**: risk factors such as smoking, excessive alcohol intake, glucocorticoid therapy, malabsorption and underlying bone marrow malignancies need to be identified. Testosterone replacement therapy is indicated in men with proven hypogonadism, but not in eugonadal men, due to an increased risk of developing prostate cancer. There is reasonable evidence for the efficacy of bisphosphonates and parathyroid hormone (PTH teriparatide) in men with osteoporosis.
- **Treatment of frail older people**: older people are more likely to have several risk factors for fracture, including previous fractures, but are also often under treated.
  - Osteoporosis treatment must take account of the likelihood of co-morbidity and multiple therapies.
  - For those in residential care, vitamin D deficiency is very common (45% of women in high level care have frank deficiency with the
remainder in the lower half of the reference range). Adjunctive therapy with calcium and vitamin D is particularly important in this group.
- Consider fall prevention strategies. There is evidence for the efficacy of hip protectors in institutionalised elderly, however compliance with hip protectors is poor.
- Consider encouragement of activities such as balance training, Tai Chi or Yoga.

TREATMENT CHOICES

• DRUG THERAPY

• LIFESTYLE MANAGEMENT

“The purpose of treatment is to reduce morbidity and mortality associated with the first fracture and all subsequent fractures.”

(MJA Supplement)

DRUG THERAPY

FIRST-LINE THERAPY

• Calcium supplementation and vitamin D assessment/replacement plus appropriate lifestyle measures should be considered as first line therapy.
• The potent bisphosphonates – risedronate (Actonel) and alendronate (Fosamax) – are effective first-line options for vertebral, hip and non-vertebral fracture prevention, demonstrating approximately 50% reduction in vertebral fractures in studies of women with one or more baseline spinal fractures. The reduction in fracture rate is seen within 12-18 months. These agents have also been shown to reduce bed day use and healthcare costs.

KEY POINTS

• Calcium and vitamin D status should be reviewed in all patients with osteoporosis. Calcium in combination with vitamin D is recommended for elderly nursing home residents.
• Risedronate and alendronate are effective first-line options for vertebral, hip and non-vertebral fracture prevention. Strontium ranelate is a recent addition to first-line therapies.
• Raloxifene is an effective first-line option for vertebral fractures.
• There is less evidence for anti-fracture efficacy of fluoride, etidronate, anabolic steroids, active vitamin D metabolites and calcitonin. These are not considered first-line agents for patients with osteoporotic fractures.
3. THE FRACTURE CASCADE

**DRUG THERAPY**

- **Drug Therapy**
  - If the aim is to reduce the risk of vertebral fractures, any one of the first-line agents – raloxifene (in postmenopausal women), risedronate, alendronate or strontium ranelate – are suitable.
  - If the aim is to reduce the risk of non-vertebral fractures, e.g. in women over 70-75 years with low femoral neck BMD, a potent bisphosphonate or strontium ranelate should be used.
  - The anabolic agent parathyroid hormone (PTH - teriparatide), which stimulates bone formation and hence bone strengthening, has been shown to markedly reduce the incidence of spinal and non-spinal fractures in postmenopausal women with prior spinal fractures. It is available in Australia for people with established osteoporosis who have had fractures, for whom other agents are considered unsuitable. (It is not PBS listed.)

**MEDICATIONS FOR PREVENTION OF FRACTURES AVAILABLE ON THE PBS**

From April 1, 2007, men and women aged 70 years and over with a BMD T-score of ≤ -3.0 can now receive treatment for osteoporosis on the PBS (without having sustained a fracture). Alendronate in the form of Fosamax, Fosamax-Plus and Alendro are now PBS listed. From August 1, 2007 Risedronate in the forms of Actonel and Actonel-Combi will also be available on the PBS for the same indication.

**HOW TO TAKE BISPHOSPHONATES**

Generally, bisphosphonates should be taken first thing in the morning on an empty stomach with a glass of water. You should remain upright for half an hour after taking them and not eat or drink anything else in that half hour. As well, calcium supplements and oral bisphosphonates should be taken several hours apart. Otherwise the absorption of one can interfere with the other.
NEW FIRST-LINE AGENTS

- Strontium ranelate (Protos), is a new agent that has both antiresorptive and bone-forming properties that has recently received PBS listing for prevention of vertebral and hip fractures in women with osteoporosis. It is a daily oral medication.
- Ibandronate sodium (Bon Viva), is a new bisphosphonate which has TGA approval but is not yet listed on the PBS. It is a once monthly oral bisphosphonate for the management of postmenopausal osteoporosis.

JAW OSTEONECROSIS WITH BISPHOSPHONATES

The adverse event of jaw osteonecrosis has been most commonly reported with the use of intravenous bisphosphonates (zolendronate and pamidronate) in cancer patients. Several cases have been reported in people taking oral bisphosphonates for osteoporosis but generally most cases have been the result of high IV doses, 4-10 times higher than oral bisphosphonate doses. This problem can be precipitated by dental extractions. It remains a rare problem for people on oral bisphosphonates however, it is important to be aware of this potential side effect.

LIFESTYLE MANAGEMENT

Lifestyle management plays an important role in maintaining bone strength throughout life and can help to prevent falls and fractures and speed rehabilitation in later life.

NUTRITION

*The two key nutrients to consider for bone health are calcium and vitamin D.*

*Calcium and vitamin D nutrition (key modifiable risk factors for developing osteoporosis) are important in the maintenance of musculoskeletal health and can have broader effects on health in general.*

**Calcium**

- More than half of all Australian adults do not meet the recommended intake of calcium.
- The efficiency of calcium absorption declines with age, so over time, people require higher amounts of calcium.
- The nutrient reference value (NRV, previously known as the Recommended Daily Intake) is 1000mg calcium per day for most adults. 1300mg calcium per day is recommended for all postmenopausal women and men aged over 70 years.
- Dairy products are a rich source of calcium. The simplest way to ensure sufficient daily calcium is to include 3 serves per day of high-calcium foods like milk, cheese or yoghurt. Many calcium-enriched products are now available for those who cannot tolerate dairy products.
Calcium Supplementation

- Other good sources of calcium include certain green vegetables (e.g. broccoli, curly kale, bok choy); whole canned fish with soft edible bones (e.g. sardines, pilchards); nuts (especially almonds and Brazil nuts); and tofu set with calcium.
- Calcium-fortified foods and drinks are also available.
- The risk of dietary calcium deficiency is reduced when calcium is included in the treatment regimen.

Calcium Supplementation

- Calcium supplements are recommended for people over 65 years, those with insufficient dietary calcium intake, as secondary therapy for the treatment of postmenopausal osteoporosis and for those taking corticosteroids for more than 3 months.
- Calcium supplementation in postmenopausal women and the elderly has been shown to slow the rate of bone loss. These effects are modest, as shown by increases in bone density and reduction in excessive bone turnover.
- Calcium supplementation of between 500-1500mg/day is generally safe although constipation has been reported. There is no evidence of increased kidney stones from taking calcium supplements in the recommended amounts.
- Supplements containing calcium carbonate require gastric acidity for optimal absorption and should therefore be taken with meals. Supplements containing calcium in other forms, such as citrate, do not require gastric acidity.
- There is no significant difference in absorption of calcium from supplements compared with different dietary sources (excluding foods rich in phytate or oxalate).

It is critical that calcium supplements and oral bisphosphonates are taken at least several hours apart, as calcium binds with these medications and prevents their absorption.

WHO NEEDS TO EAT WHAT?

- Children 5 to 9 years should aim for 2 to 3 serves of calcium-rich foods each day to reach a total intake of 800-1000 mg/day.
- Children and adolescents aged 9 to 18 years should aim for 3 serves of calcium-rich foods a day to reach a total intake of 1000-1300 mg/day.
- Adults need at least 1000 mg of calcium per day; women aged over 50 and men aged over 70 require at least 1300 mg of calcium per day.
Vitamin D

- Vitamin D is essential for the development and maintenance of bone. It assists calcium absorption from food in the intestine, and ensures the correct renewal and mineralisation of bone tissue.
- For most Australians, the main source of vitamin D is sunlight exposure. Cholecalciferol (vitamin D₃) is formed in the skin through the action of ultraviolet light on 7-dehydrocholesterol to produce cholecalciferol.
- Vitamin D is obtained from the diet as ergocalciferol (vitamin D₂). Food sources of vitamin D are limited; it is found in small quantities in a few foods, such as fatty fish (salmon, herring, mackerel), liver, eggs and fortified foods.
- Vitamin D₃ appears to be more effective than D₂ in raising serum 25-hydroxyvitamin D and is more reliably measured in many commercially available assays.
- Vitamin D deficiency increases the risk of osteoporosis, falls and fractures in the elderly.

To get enough sunlight to produce vitamin D, a person needs to expose their hands, face and arms (or equivalent area of skin) to sunlight for about 6-8 minutes each day. For moderately fair people, sun exposure should take place just before 10am or after 2pm (standard time in summer). This would produce around 1000 IU of vitamin D – around one third of a minimal erythemal dose (MED).

Minimal erythema dose (MED)

- One MED is the amount of sun exposure that produces a faint redness of the skin. Exposure of around 15% of body surface (e.g. hands, face and arms) to around one-third of a MED would produce approximately 1000 IU (International Units) of vitamin D.

GROUPS MOST AT RISK OF VITAMIN D DEFICIENCY ARE:

- the elderly;
- people who are housebound or in residential care;
- naturally dark-skinned people;
- those who cover their skin for cultural or religious reasons; and
- babies of vitamin D deficient mothers.
Vitamin D Supplementation

- The daily vitamin D requirement is at least 400-600IU.
- For people who do not get adequate sun exposure for a variety of reasons, then a supplement of at least 400IU per day is recommended.
- As vitamin D and calcium deficiency are common in older people especially those who are housebound or in residential care, a calcium-vitamin D combination is recommended to reduce the risk of falls and fractures.
- Vitamin D replacement is safe, generally not causing hypercalcaemia or hypercalciuria, even in higher doses up to 600,000IU (15mg) once per year by intramuscular injection (this must be specially imported by a doctor).
- In people with severe vitamin D deficiency, higher replacement doses (around 5,000-10,000IU [125-250mcg] per day) are often required to achieve normal vitamin D levels and optimal bone health. This treatment should be supervised by a medical practitioner.
- People who wear traditional or religious dress that covers most of the body are also at increased risk of vitamin D deficiency and may require supplements.
- Adjunctive therapy with some form of vitamin D should be considered for postmenopausal women and older men who take corticosteroids. People should be regularly tested for hypercalcaemia.

TABLE 2  SUN EXPOSURE TO ACHIEVE SUFFICIENT VITAMIN D FOR PEOPLE WITH MODERATELY FAIR SKIN*

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*Sun exposure times resulting in 1/3 minimal erythemal dose. Exposure times for people with highly pigmented skin would be three to four times greater. † 11am or 3pm daylight saving time, respectively. Adapted from: Working Group of the Australian and New Zealand Bone and Mineral Society, Endocrine Society of Australia and Osteoporosis Australia. Vitamin D and adult bone health in Australia and New Zealand: a position statement. Med J Aust 2005: 182: 281-284.
4. CALCIUM INTAKE AND RECOMMENDATIONS

Special Considerations for calcium and vitamin D in the elderly

*International Osteoporosis Foundation*

Elderly persons are at increased risk for calcium and vitamin D insufficiency. There are also several alterations in body functions that can contribute to calcium loss from bone, and hence increase the risk of osteoporosis.

Ageing is associated with:

- Reduced intake of dietary calcium, usually as a result of decreased overall dietary energy intake (e.g. poorer appetite, inter-current illnesses, social and economic factors)
- Decreased intestinal absorption of calcium (exacerbated if vitamin D status is low)
- Decreased capacity of the intestinal cells to adapt to a low calcium intake, and increase their absorptive capacity
- Less frequent exposure to sunlight (e.g. elderly who are housebound, institutionalised, or have reduced mobility), hence poorer vitamin D status
- Decreased capacity of the skin to synthesise vitamin D
- Decreased efficiency with which the kidneys can retain calcium, leading to increased calcium loss in the urine
- Decreased capacity of the kidneys to convert vitamin D into the most active form, 1,25-dihydroxyvitamin D.

**Other micronutrients and bone health**

- **Vitamin K**: needed for the production and functioning of osteocalcin, a compound that is required for bone mineralisation. Emerging evidence suggests that low vitamin K status may contribute to low BMD and increased risk of fragility fractures in the elderly.
- **B vitamins and homocysteine**: high homocysteine levels in the blood may be associated with lower BMD and increased risk of hip fractures in older people. Homocysteine may have adverse effects on bone by interfering with the formation of collagen. Homocysteine levels in the blood can rise when there is inadequate intake of vitamins B6, and B12 and folic acid.
- **Vitamin A**: very high intake of vitamin A (well above recommended daily levels) may have adverse effects on bone, however, the role of high levels of vitamin A and fracture risk is controversial.
- **Magnesium**: involved in calcium homeostasis and the formation of hydroxyapatite (bone mineral). Elderly people may be at risk of mild magnesium deficiency because absorption decreases with age and renal excretion increases with age. However, there is currently no evidence linking low magnesium levels with fracture risk.
- **Zinc**: plays a role in the regulation of bone turnover and bone mineralisation. Mild zinc deficiency has been reported in elderly people and may potentially contribute to poor bone status.
Exercise helps to build and maintain strong bones and prevent falls and fractures.

Exercise can also play a crucial role in rehabilitation. Muscle strengthening exercises can help to rebuild bone in people who have developed osteoporosis, provide pain relief and speed the rehabilitation process.

**DEFINITION OF EXERCISE TERMS**

- **Weight-bearing exercise**
  Use of large muscle groups in a rhythmic pattern in a standing position, at a rate that increases heart rate, blood pressure and breathing to at least a ‘moderately hard’ level. Examples are: brisk walking, hiking, stair climbing, jogging and aerobic dance. (Swimming, cycling, seated steppers and arm exercises are examples of nonweight-bearing aerobic exercises)

- **Resistance training (weight lifting exercise)**
  Use of targeted muscle groups to lift and lower moderate to heavy weights slowly.

- **Power training**
  Weight lifting exercise performed so that the lifting phase is done as fast as possible, and the lowering is done slowly.

- **High impact exercise**
  Exercises in which the bones of the spine and lower extremities are loaded forcefully and rapidly as the feet hit the ground. Examples include: jumping, rope skipping, hopping up or down stairs, jumping off boxes and sports involving jumping, such as basketball.

- **Balance exercises**
  Exercises that stress the equilibrium by narrowing the base of support, removing vision, decreasing foot contact with the ground and changing the centre of mass. Examples include: standing on one leg with eyes closed, sitting on an exercise ball, heel-to-toe walking, leaning as far as possible in all directions while standing without bending at the waist, Tai Chi and balancing while placing a pillow or rocker board under the feet.


- Exercise and bone maintenance are inextricably linked.
- Regular weight-bearing exercise and strength training can prevent bone loss associated with ageing and menopause.
• By improving balance, co-ordination, strength and agility, exercise helps to prevent falls that lead to fractures.
• Exercise helps to speed the rehabilitation process after fracture.
• Regular weight-bearing, impact and resistance exercises are best for people with osteoporosis. **High-impact activities are only recommended for people with osteoporosis who don’t have fractures.**
• Exercising the spine during middle-age may help prevent the vertebrae from weakening or fracturing later in life.
• People with fractures should only undertake low-intensity exercise and gentle strengthening programs (e.g. Tai Chi and hydrotherapy) and avoid high impact exercise with jarring and twisting movements, to prevent further fractures.
• Exercise can help to relieve the pain and some of the symptoms of increased kyphosis and other postural changes.

ROLE OF EXERCISE AND OSTEOPOROTIC PREVENTION

• Osteoporotic fracture is a multifactorial problem requiring a holistic approach to prevention for optimal efficacy and safety.
• Targeted exercise addresses many of the risk factors for osteoporotic fracture, including osteopenia, muscle wasting and weakness, falls, poor balance, depression, use of medications for depression and insomnia, sedentariness, fear of falling, mobility impairment and disability.
• Concurrent management of fracture risk with a physical activity prescription, adequate nutrition and pharmacotherapy for osteoporosis when required offers the best approach to optimal bone health.
• The important elements of the exercise prescription for bone health include high-intensity progressive resistance exercise (weight lifting), progressive balance training, moderate to high intensity weight-bearing aerobic exercise and, when feasible, high impact exercise.


Exercise and the prevention of osteoporosis

• Bones need nourishment and the mechanical stress of physical activity to remain strong and healthy. Daily exercise helps to keep bones and muscles strong, maintains flexibility and reduces the chances of injury.
• People who exercise regularly have greater bone density than people of the same age who are inactive.
• To have an effect on bone, exercise needs to be REGULAR, PROGRESSIVE, FAIRLY VIGOROUS, HAVE VARIETY (put different loads on it), and performed in SHORT INTENSE BURSTS.

• Types of exercise required for bone health: weight-bearing and strength-training. High impact exercises should also be included where feasible.

• Good weight-bearing exercises for bones include walking, jogging, dancing, tennis, volleyball, golf.

• Strength training should involve resistance training, preferably using weights.

• Two short exercise sessions separated by 8 hours are better than one long one.

• If exercise time needs to be reduced, it is better to reduce the length of each session rather than the number of sessions per week.

Advise patients to:
- Start slowly and progress gradually
- Do activities that they enjoy, and make it fun
- Set short-term goals for what they want to achieve
- Exercise with a friend or in a group
- Keep an exercise diary
- Be aware of pain: report any pain to a healthcare professional
- Tai Chi and other regimens that promote muscle strength, balance and co-ordination are good for falls prevention
- Go for a short brisk walk (20 minutes): this may be more beneficial to bone than a long slow walk of about an hour.

PREScribing EXercise For OSTeoporOTIC PREVeNTion

• The most important elements of the exercise prescription for bone health are high intensity progressive weight lifting exercise and progressively more difficult balance training, with the addition of high impact exercise (such as jumping) when feasible.

• The most economical prescription with the broadest benefits for body composition and bone health as well as neuromuscular function is progressive resistance training as the primary exercise modality.

• Continuous progression of weight moved, balance exercise difficulty and jump height is the most critical element of the exercise prescription for bone health; if progression stops, so does adaptation in the bone and muscle.

• Given the short time (several minutes per day) that is necessary for effective high impact exercise or balance training, incorporating such episodes into daily activities may be more successful than planning structured exercise classes away from home.

PRINCIPLES OF EXERCISE THAT MAXIMISE BONE ADAPTATION

- Rapid, short bursts of high intensity and/or high impact activities such as jogging, jumping and rope skipping are more stimulating to bone cells than sustained, low impact activity such as walking.
- Effective activity does not have to be weight-bearing. Resistance training is an effective nonweight-bearing activity.
- Aerobic activity that is nonweight-bearing (such as swimming or cycling) does not enhance bone density.
- Lifting heavy weights is more effective than lifting light weights.
- Lifting heavy weights rapidly (power training) seems to be more effective than lifting heavy weights slowly (traditional resistance training).
- Exercising in short bouts with rest periods between has been shown in animal models to be more effective than continuous, long periods of exercise.
- Rapid movements are more stimulating than slow movements.
- Novel forces, such as changing directions and different heights of jumps, are more stimulating than repetitive force patterns.
- As the response of the bone to muscle contraction is a local phenomenon, muscles connected to clinically important bones susceptible to osteoporotic fracture (hip, wrist, thoracic spine) need to be targeted specifically to achieve protection at those skeletal sites.


IF YOUR PATIENT HAS OSTEOPOROSIS AND FRACTURES

Develop a physical activity program that does not involve high-impact or twisting activities but rather focuses on low-impact exercise. Hydrotherapy can be particularly useful to provide gentle strength training and encourage muscle relaxation.

Supervision by a physiotherapist can help to:
- Reduce the risk of further injury through falling
- Ensure that the program is suited to the patient’s needs
- Relieve acute pain.

Advise patients to:
- Avoid high impact activities
- Avoid jarring and twisting movements
- Avoid heavy lifting
- Avoid sudden, abrupt movements
- Don’t overdo it (especially if they have done no activity for many years).
Before commencing any exercise program, people who have severe osteoporosis and/or several fractures should see a physiotherapist or GP for an individual exercise program.

FALLS PREVENTION STRATEGIES

- Falls are responsible for 90% of hip fractures and 50% of vertebral fractures in older patients, so one of the main aims of exercise programs in this group should be to reduce the number of falls.

- Risk factors for falls include: impairment of vision, sensation, strength and balance, and patient thinness and frailty.

- Quadriceps strength and postural sway have been found to be as important as BMD in predicting male and female fractures.

- Exercise that increases muscle strength and improves co-ordination may reduce the risk of falls.

- The risk of falls can be reduced by:
  - Falls prevention programs, including muscle strengthening
  - Balance training: eg home based physiotherapy or Tai Chi (47% decrease in falls and 25% less hip fracture rate in practising individuals)
  - Regular exercise
  - Environmental modifications (eg removing mats, improving lighting)
  - Correct footwear: recommend firm fitting, flat shoes
  - Optimising patient vision
  - Appropriate use of walking aids
  - Use of trochanteric padding (hip protectors)
  - Optimising treatment of medical conditions associated with falls eg hypotension
  - Reduction in psychotropic medication use and polypharmacy

Physiotherapy assessment that includes postural assessment and an abdominal strengthening program is recommended.
TIPS FOR PATIENTS ABOUT FALLS PREVENTION

• It’s never too late to start exercising!
  Balance is a skill you can keep or recapture at any age.

• Exercise regularly
  This keeps the balance ‘tuned up’ and bones and muscles strong.

• Exercise within your limits
  Problems such as diabetes, arthritis or asthma should not stop you exercising.
  Your physiotherapist can tailor a specific exercise program for you.

• Maintain good posture
  Good spinal care throughout your life will assist your balance.

• Walking aids such as sticks and frames should be correctly prescribed and fitted
  Not borrowed from other people.

• Choose proper footwear
  Firm fitting, flat shoes improve your stability.

• Take extra care on uneven ground
  Surfaces such as gravel and grass are more challenging to the balance.

• Good vision helps your balance
  Be careful if lighting is poor and avoid walking in the dark.

• Be aware of home hazards
  Slippery mats, dangling electrical cords and clutter can turn your home into an obstacle course.

• Have a ‘Falls Emergency Plan’
  Know how to summon help if you do have a fall. Ask your physiotherapist to show you the easiest way to get up off the floor.

These tips are provided by the Australian Physiotherapy Association and used with permission.

Hip Protectors

• Hip protectors have been reported to reduce hip fractures in some, but not all, clinical trials in high-risk populations (residential care).

• Compliance with wearing hip protectors is a major problem.

Individually tailored exercise programs include balance training to reduce the likelihood of having a fall.
C. MANAGEMENT OF FRACTURES TO MINIMISE THE FRACTURE CASCADE

“Rehabilitation to independent living is the primary goal after any fracture.”

(MJA supplement)

Optimal care of fragility fracture patients includes not only management of the presenting fracture but also investigation, diagnosis and treatment of underlying causes of the fracture, including osteoporosis or other medical conditions.

VERTEBRAL FRACTURES

- A first vertebral fracture often goes unrecognised – patients often attribute back pain to ageing, while healthcare professionals may diagnose a non-specific musculoskeletal condition and treat symptomatically. This means significant spinal remodelling may have occurred before treatment can be started. Additionally, a woman’s first vertebral fracture makes her 4 times more likely to have another fracture within the next year.
- Vertebral fractures are recognised through physical examination: examine for loss of height, kyphosis and spinal bone tenderness. X-rays may also reveal evidence of osteoporosis and incidental fracture.
- The pain from vertebral crush fractures is usually short-term (6-8 weeks) and should resolve as the fracture heals.

Management of vertebral fractures

- For minor vertebral fractures, conservative treatment is appropriate and consists of:
  - pain relief with non-steroidal anti inflammatory drugs (NSAIDs)
  - abdominal exercises and bracing
  - physiotherapy, particularly hydrotherapy
- For patients suffering from multiple crush fractures specific management programs should include:
  - Medications, in combination with pain relieving strategies, e.g. TENS (transcutaneous electrical nerve stimulation) and relaxation techniques.
  - Opiate therapy may be indicated and pain management consultation may be required.
- Where pain persists, several surgical techniques have proven effective for some people. These include:
  - Vertebroplasty: ‘cement’ is injected percutaneously (through the skin) into the vertebrae.
  - Kyphoplasty: an expandable balloon is put into a vertebra and inflated. The cavity created in the bone is then filled with cement.
HIP FRACTURES

- More than 95% of patients require surgery to repair their hip fracture, and of these, fewer than one-third will regain normal functioning; a further one-third have to give up independent living and need constant care.
- After a hip fracture, 1 in 5 people will die within 12 months, up to 1 in 4 will need nursing home care, and 2 out of 3 will never return to their previous level of independence and ability to perform activities of daily living.
- Recognised risk factors for poor functional recovery following a hip fracture include older age, post-fracture depression, lack of social support and low ability to function properly prior to the fracture.

Management of hip fractures

- Intensive exercise training can lead to improvements in strength and function in elderly patients who have had hip replacement surgery. Patients treated with exercise therapy (rehabilitation programs) have been shown to be better at getting up, walking, climbing stairs and maintaining posture compared to patients who haven’t been treated with an intensive exercise program following surgery.
- Coordinated geriatric hip-fracture programs and early discharge (with support) for selected patients have been shown to significantly increase the return-home rates, reduce length of stay in hospital and total costs.
- Pain management treatments such as medication, hot or cold applications, TENS and acupuncture are more successful when used in combination with self-help techniques such as relaxation, meditation and hypnosis. Courses to learn these techniques are generally conducted by local hospitals and community centres.
- Patients should continue rehabilitation at home or as an outpatient at the hospital.
- Home-based rehabilitation after any fracture typically includes various combinations of muscle strength conditioning, ambulation, transfer and balance training supervised by a physiotherapist.
- Walking aids, such as frames, may be recommended and supplied by a physiotherapist. Patients should be encouraged to maintain these exercises and advised to avoid extremes of movement following total hip replacements.
- Practical equipment should be arranged by the occupational therapist prior to discharge, following a home visit and assessment. These include raised toilet seats and shower chairs, ramps and handrails. Positioning the telephone and other items that are used regularly within easy reach should also be recommended.

A personalised exercise program is an important aspect of rehabilitation after fracture. This image shows exercises used in a specialized rehabilitation program under professional supervision.
A FRACTURE PREVENTION GUIDE

Healthcare professionals can promote healthy lifestyles and self-management to optimise health outcomes for their patients.

Prevention of first and subsequent fractures is the goal of treatment for patients with osteoporosis.

TREATMENT RECOMMENDATIONS:

General

- Discuss the risk of osteoporosis and related problems with all patients aged over the age of 60, especially those at high risk.
- Consider GP referral for BMD testing of postmenopausal women who exhibit one or more risk factors for osteoporosis, and men who may be at risk.
- Advise elderly patients to have their eyesight checked regularly.
- Check for conditions that may cause secondary osteoporosis.

Nutrition

- Emphasise the importance of maintaining adequate calcium (1300mg/day for people aged over 70 years) and vitamin D (at least 400–600IU daily) intake.
- Make appropriate recommendations regarding vitamin D and ways to safely enhance levels.
- Review patient nutrition and recommend supplements as appropriate.

Physical activity

- Encourage participation in regular low-intensity weight-bearing and muscle strengthening exercises.
- Include balance training in the physical activity program.
- Consider ways to prevent falls (see Falls Prevention Strategies, page 26).

Please note: References and bibliography will be available on the OA website www.osteoporosis.org.au
5. WHO WE ARE

OSTEOPOROSIS AUSTRALIA

Osteoporosis Australia is an independent, not-for-profit organisation, managed by a CEO, Board of Directors and a Medical and Scientific Advisory Committee.

Our goal is to reduce the incidence of osteoporosis and osteoporotic fractures in the Australian Community.

Our services include:

- Toll-free information line for consumers (1800 242 141)
- Educational materials for consumers and health professionals
- Osteoblast magazine for consumers and health professionals
- Osteoporosis Prevention and Self-Management Program for consumers
- Regular community education seminars and national education programs for health professionals, primary school students and residents of retirement villages and residential aged care centres.

Our activities include:

- Joint Position papers with ANZBMS (Australia and New Zealand Bone and Mineral Society)
- Clinical update days for health professionals
- National Healthy Bones Week: first week in August
- World Osteoporosis Day: October 20
- Supporting medical research in osteoporosis-related areas, through the OA research fund (established 2003)
- Health Professionals Program:
  - GP and Pharmacy Guides
  - Vitamin D and Calcium Program
  - Fracture Prevention Awareness Program
  - Falls Prevention Project

For information about our services and activities, contact OA in your State 1800 242 141 or visit our website www.osteoporosis.org.au (contains a Medical Professionals Section).
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