Osteoporosis and fragility fractures are significant public health problems, particularly in an ageing population. It is estimated that 3 million people in the UK have osteoporosis, resulting in more than 500,000 sustaining a fragility fracture each year (National Osteoporosis Society, 2015). The cost of treatment alone is estimated to be £4.3bn per year in the UK (Royal College of Physicians, 2017; Svedbom et al, 2013).

Fragility fractures caused by osteoporosis have a high cost not only for the NHS, but also for individuals and society. Their impact is often hidden but devastating, yet public awareness of osteoporosis remains low – only 25% of adults are familiar with the term (NOS, 2014) – and progress on prevention and management has been slow. This article discusses the physiology and burden of osteoporosis, risk assessment to prevent fractures, the role of fracture liaison services (FLSs) and pharmacological and non-pharmacological prevention strategies.

Bone physiology
Bone consists of a thick outer shell of ‘cortical’ bone and inner honeycomb-like ‘trabecular’ bone. Living bone tissue is made up of a collagen matrix hardened by calcium salts and other minerals. This makes bone strong and flexible, able to protect vital organs, support the body, and work alongside muscles to allow movement. Bone contains 99% of all the calcium in the human body and can release this, and other minerals, when needed.

Throughout life, bone tissue renews and repairs itself (bone remodelling) through complex interactions between osteoblasts (cells that build new bone) and osteoclasts (cells that remove old bone). This process alters with age and can also be affected by genetic and environmental factors; this is partly what determines our peak bone mass at maturity (around the age of 30 years) and our rate of bone loss (starting from around the age of 40 years) (Fig 1). As bone strength declines with age, silently and gradually, there are often no symptoms of

In this article...
- Role of nurses in identifying and managing osteoporosis
- Risk factors for osteoporosis and fragility fracture
- Preventive strategies to improve bone health and avoid fractures

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Osteoporosis: risk assessment, management and prevention

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Abstract Osteoporosis can have devastating effects, yet awareness of the condition remains low; many people do not know that men can have it as well as women. Although it is not harmful in itself, osteoporosis weakens bones and therefore commonly causes fragility fractures. These can be the first of a series of fractures and lead to a downward spiral of deterioration and loss of independence. This article provides a comprehensive overview of osteoporosis, its definition, why it can be a burden, and how diagnosis, assessment and management can be performed. Early diagnosis and prevention strategies can improve bone health and reduce fracture risk. Fracture liaison services, where they exist, are a recognised resource to systematically identify, assess, treat and refer patients.

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Fig 1. Peak bone mass and age-related bone loss

![Graph showing peak bone mass and age-related bone loss for men and women.](Source: Adapted from Compston (1990))

Osteoporosis

The World Health Organization (1994) defined osteoporosis as “a disease characterised by low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk”. In osteoporosis, bones lose their strength and are more likely to break, usually after a minor bump or fall. The disease can also be described as low bone density as measured on a dual-energy X-ray absorptiometry (DXA) scan.

Well recognised in women, osteoporosis remains under-recognised and under-treated in men. Although it is seen mostly in older people, it can also be pregnancy associated or transient and idiopathic in children and young adults, but these are rare forms of the disease.

Osteoporosis is not harmful or painful in itself. Most people with below-normal bone density are unaware of it until a fragility fracture occurs. Healthy bones are usually able to withstand a simple fall so, if a fracture occurs in these circumstances, it indicates a fragility fracture with possible underlying osteoporosis.

Fragility fractures

Half of women and a fifth of men over the age of 50 years will sustain a fracture in their lifetime, usually as a result of low bone strength (Van Staa et al, 2001). Multi-centre studies on fracture incidence show that an untreated fracture can give rise to more fractures through a “fragility fracture cycle” (Cooper et al, 2011). If all patients who sustained a low-trauma fracture were treated, as many as 54,000 subsequent fractures in the following five years could be prevented (RCP, 2017).

Fragility fractures occur most commonly in the:
- Spine (vertebrae);
- Wrist (distal radius);
- Hip (proximal femur).

They can:
- Cause pain;
- Limit activity;
- Reduce independence and confidence;
- Impair quality of life (NOS, 2014).

Fig 2 shows the added morbidity and dependence created by three types of fracture – Colles, vertebral and hip – at different ages.

Vertebral compression fractures are the most common, most-often undiagnosed and poorly reported of all osteoporotic fractures (NOS, 2017). If they remain undiagnosed and untreated, the opportunity to prevent further fractures is missed. A fifth of women with osteoporosis who have had a first vertebral fracture will sustain a second one within a year (Johnell et al, 2001), while >55% of patients with hip fracture have evidence of having previously had a vertebral fracture (Gonnelli et al, 2013).

Vertebral compression fractures can cause chronic back pain, as well as postural changes (spinal curvature, known as kyphosis) and height loss that can, in turn, lead to shortness of breath, a protruding abdomen, feeling full after small meals and continence problems.

Risk assessment

Determining bone strength helps when assessing the risk of future fractures: the lower the bone density, the higher the risk of fracture. However, osteoporosis being indicated on a bone density scan is only one of many risk factors for fracture – not all those individuals who have low bone density will fracture a bone easily. As such, assessing risk factors is key to early detection and preventive treatment. This allows for a more accurate prediction of the risk of fragility fracture than that provided by the measurement of bone density alone.

Fig 2. Added morbidity and dependence due to fracture

![Graph showing added morbidity and dependence due to fracture.](Source: Adapted from Kanis and Johnell (1999))

A Colles fracture is a complete fracture of the radius in the forearm, near to the wrist, which results in posterior displacement and obvious deformity.
Risk factors for fragility fracture

Fracture risk assessment is recommended in women aged <65 years and men aged <75 years if risk factors are present. These include:

- Previous fragility fracture
- Current use or frequent recent use of oral or systemic glucocorticoids
- History of falls
- Family history of hip fracture
- Other causes of secondary osteoporosis
- Low body mass index (<18.5 kg/m²)
- Smoking
- Excessive alcohol intake – this previously stood at >14 units per week for women and >21 units per week for men but has recently been revised by government to >14 per week for everyone (UK Chief Medical Officers, 2016)

Source: National Institute for Health and Care Excellence (2012)

Risk factors

Fragility fractures are more common in women than men, as women tend to have smaller frames, live longer and experience more bone loss, including:

- Rheumatoid arthritis
- Inflammatory bowel disease (such as, Crohn’s disease and ulcerative colitis)
- Malabsorption conditions (for example, coeliac disease)
- Anorexia
- Hyperthyroidism
- Hyperparathyroidism
- Vitamin D deficiency
- Type 1 diabetes
- Liver disease

In women, premature menopause (occurring before the age of 45) – whether natural or induced by surgery, chemotherapy, radiotherapy or endocrine therapy – may increase the risk of fracture. A history of anorexia and no periods can signal low oestrogen levels and, therefore, also be a risk factor.

Some risk factors affect bone strength indirectly. A low body mass index (<8.5 kg/m²) can increase fracture risk because of reduced bone tissue overall and less cushioning in case of a fall – but being obese can also affect bone strength. Women who smoke may have an earlier menopause and smoking has a direct harmful effect on osteoblasts. Excessive alcohol intake (>14 units per week) can affect both osteoblasts and osteoclasts, and increase the risk of falls.

The National Institute for Health and Care Excellence (2012) recommends assessing fracture risk in all women aged ≥65 years, in all men aged ≥75 years, and in women aged ≥65 years and men aged <75 years with risk factors (Box 1).

NICE (2012) further states that, in people aged <50 years, fracture risk assessment is not needed unless they have major risk factors – for example, current or frequent recent use of oral or systemic glucocorticoids, untreated premature menopause or previous fragility fracture.

Risk calculators and imaging

FRAX (sheffield.ac.uk/FRAX, Kanis et al, 2008) and QFracture (qfracture.org, Hipisley-Cox and Coupland, 2009) are simple online calculators to assess the risk of fracture. Patients found to be at high risk can be offered treatment without further testing. A DXA scan measures BMD in the lower spine and hip. A T-score of <−2.5 (2.5 standard deviations below the average range in young and healthy women) is the point at which osteoporosis is diagnosed in post-menopausal women and older men. DXA results can be used to recalculate the FRAX score to get a more accurate risk value. A vertebral fracture assessment identifies vertebral fractures using DXA and can be performed at the same time as the bone density scan.

Fracture liaison services

For people with a new-incident low-trauma fracture, the risk of further fracture is five times higher than normal in the first year, and investigations are carried out to assess bone health and the need for a falls risk assessment. Information is provided to enable patients to understand future fracture risk and self-management. Interventions are given to improve bone health and referrals are made to specialist services. Integration of patient care through primary and secondary care via comprehensive communication of management plan.
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during which nearly a quarter of further fractures will occur (Kanis and Johnell, 1999). A first fracture is therefore a crucial point for assessment and preventive treatment. This is where FLSs play a key role: if these services identified and treated everyone aged >50 years who sustains a fracture, 22,250 hip fractures a year could be prevented (McLellan et al, 2004).

FLSs are a cost-effective, clinically proven way to systematically identify, assess, treat and refer all eligible patients aged >50 years in the local population who have sustained a fragility fracture. The services usually sit within secondary care – their function is outlined in Fig 3 – and focus on hip fracture and other fractured bones requiring hospital treatment. Fewer services exist in primary care, but these are better placed to identify those who have sustained vertebral compression fractures (NOS, 2015).

By working to protocols agreed with hospitals and GPs, FLS clinical nurse specialists identify people at risk of osteoporosis, invite them for an assessment and refer them if needed. FLS clinical standards, published by the NOS (2015), have been developed to ensure correct identification, investigation, information, intervention and integration with primary care. The NOS is also working with the NHS to establish more clinics and improve services.

Management

Osteoporosis management to reduce fracture risk includes pharmacological and non-pharmacological strategies. It has been addressed by various organisations in the past decade, so there are different approaches; some areas may have local protocols defining which patients can access which treatments.

Guidance

For England and Wales, four technology appraisals offer guidance on various drugs to prevent osteoporotic fractures in post-menopausal women and to treat osteoporosis [NICE, 2018a; NICE, 2018b; NICE, 2018c; NICE, 2018d]. Whether patients are offered one of the drugs will depend on age, BMD, and number of risk factors for fracture. Many treatment thresholds also apply to men aged >50 years.

For Scotland, the Scottish Intercollegiate Guidelines Network (2015) provides comprehensive guidance. Another useful reference is the National Osteoporosis Guideline Group’s (2017) guideline for the diagnosis and management of osteoporosis in post-menopausal women and men from the age of 50 years.

Drug treatments

Drugs that can be prescribed to prevent fragility fractures include bisphosphonates (alendronate, ibandronate, risendronate and zoledronic acid) and non-bisphosphonates (raloxifene, denosumab, teriparatide, strontium ranelate and hormone replacement therapy).

Oral bisphosphonates (alendronate and risendronate sodium) are considered a cost-effective first-line treatment option for most patients. Injectable treatments, including intravenous bisphosphonates (ibandronic acid or zoledronic acid) and subcutaneous denosumab (a monoclonal antibody), provide alternatives in case of intolerance or contraindications. Strontium ranelate Aristo, granules for oral treatment, is also available for the treatment of severe osteoporosis in both men and women, if other treatments are contraindicated or not tolerated.

Less-frequently prescribed treatments include strontium ranelate, raloxifene (which mimics the action of oestrogen), and some types of hormone replacement therapy (HRT) for women and testosterone for men. HRT is effective at preventing bone loss but is usually restricted to younger women with menopausal symptoms.

Teriparatide is a self-injected treatment that uniquely builds bone and is licensed for men and post-menopausal women at very high risk of fracturing. It is prescribed by hospital bone-health specialists who see more complex patients and often prescribe drugs in injectable form (NOGG, 2017).

Osteoporosis drug treatments have been shown to reduce the risk of fracture by around 50% depending on the drug used and adherence to treatment (Papaioannou et al, 2010). They have been shown to strengthen bone and reduce the risk of fracture, and may increase BMD.

The most-often prescribed oral bisphosphonates require the patient to fast before taking the tablet and remain upright (sitting, standing or walking) between 30 minutes and one hour afterwards. In a sample of nurses and support workers in long-term care facilities, only 52% of nurses and 8.7% of support workers responsible for drug administration administered bisphosphonates correctly (Lau, 2010). Correct administration minimises possible side-effects and encourages treatment adherence and compliance.

Periodic treatment reviews are good practice to check for side-effects, compliance, whether drugs are still needed and that the benefits of continuing the drug outweigh any potential harm. If treatment is discontinued, fracture risk should be reassessed – particularly after any new fracture or within 2 to 3 years. (NOGG, 2017).

Lifestyle measures

To maximise their bone health, all patients require support and information on positive lifestyle changes. These include:

- Adopting a well-balanced, healthy diet with adequate calcium and vitamin D;
- Doing appropriate physical activity;
- Avoiding smoking and high alcohol consumption (Box 2).

Osteoporosis is not a result of calcium deficiency and a high calcium intake and/or calcium supplementation does not guarantee protection against it. However, extra calcium and vitamin D are important if intake is insufficient. Older people who are housebound, inpatients on long-term hospital stays, or people living in residential or nursing homes can be at increased risk of calcium and vitamin D deficiency and may benefit from taking supplements (SIGN, 2015).

Physical activity including impact and muscle-strengthening resistance exercise for osteoporosis can promote bone strength to reduce fracture risk and, if managed carefully, may also help with managing the pain and symptoms associated with vertebral fractures (NOS, 2018). Fragility fractures can often result from a trip, slip or fall; interventions to enhance balance and reduce falls are considered essential as part of a comprehensive fracture reduction strategy (NICE, 2015).

Box 2. Lifestyle measures to improve bone health

- A healthy diet for strong bones needs a balance of vitamins and other nutrients, including calcium. Most people should be able to derive enough calcium from their diet, but supplementation may be necessary.
- Vitamin D is important, as it helps the body absorb calcium and regulates how it is used, ensuring bones remain strong. Again, some people may benefit from taking supplements.
- Weight-bearing through impact, resistance exercises (to strengthen bones and muscles) and those enhancing strength and balance will help reduce the risk of falls in older age and prevent fragility fractures.
- Smoking and high alcohol consumption can negatively affect bone health and should be avoided.

Conclusion

Nurses play a pivotal role in promoting bone health among all their patients, especially young people, by improving awareness and encouraging healthy lifestyles; Box 3 summarizes key action points for nurses. Another key contribution they can make is to identify individuals, in particular older people, who may have osteoporosis and benefit from bone-health assessment, fracture risk assessment and preventive treatment (Smeltzer and QJ, 2014). Finally, nurses play a key role in helping people diagnosed with osteoporosis to manage their condition. Providing clear information will improve patients’ understanding of the condition, reduce their anxieties, promote their adherence to treatment and encourage them to adopt strategies for good bone health.

Box 3. Action points

Diagnosis
- Act on any signs of suspected vertebral fracture (such as height loss, back pain, postural changes)
- In women, check for a history of amenorrhea (no periods for three years) or loss of periods
- Remember: men, too, can have osteoporosis

Education and prevention
- Include bone health in your standard patient assessment
- Educate young people, especially girls, on the need to protect their bones and how to achieve good bone health
- Promote bone health in all women, irrespective of ethnicity. Respect cultural preferences for clothing when advising on sun exposure to attain adequate levels of vitamin D
- Refer anyone aged >50 years who has had a fragility fracture to the fracture liaison service or their GP for assessment, a bone density scan and treatment and/or lifestyle advice

Management
- Help patients understand the benefits and risks of treatment so they can make a balanced, informed decision
- Ensure you understand how drugs are administered and explain this clearly to patients
- Ask patients about adverse effects, adherence to treatment and whether a long-term treatment review is due
- Check patients’ intake of calcium and vitamin D is adequate or consider supplementation
- Recommend appropriate exercise combinations, including balance and strength training, impact and progressive strengthening alongside safe back care (National Osteoporosis Society, 2018)
- Focus on preventing falls in those at risk, following the National Institute for Health and Care Excellence’s (2013) falls risk assessment and reduction guidance

References

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