



International  
Osteoporosis  
Foundation

# THE BREAKING SPINE



# Key Messages

## VERTEBRAL FRACTURES ARE COMMON

- One new spinal fracture occurs every 22 seconds worldwide.
- Vertebral or spinal osteoporotic fractures are the most common type of fragility fracture, yet remain largely undiagnosed and untreated.
- Most vertebral fractures are a complication of low bone mass or osteoporosis.
- 20-25% of Caucasian women and men over 50 years have a prevalent vertebral fracture.
- One in five women with a vertebral fracture will sustain another one within twelve months – *the fracture cascade*.

- The risk of future vertebral fractures increases with the number of prior vertebral fractures: compared to women without vertebral fractures, having 2 or more prevalent vertebral fractures increases the risk 7-fold of having another vertebral fracture within a year.
- In women over 80 years, 50% have a prevalent vertebral fracture.

## VERTEBRAL FRACTURES ARE UNDER-DIAGNOSED AND UNDER-TREATED

- Although many spinal fractures cause pain and disability, they are often ignored or treated as simple back pain.

- Mild and moderate vertebral fractures are frequently not recognized or reported in the patient's medical record, leading to under-diagnosis and under-treatment.
- In elderly hospitalised patients who had a lateral chest X-ray, fewer than 50% of vertebral fractures later identified on X-rays were reported in the radiological reports.
- Only about 40% of older women with vertebral fractures visible on X-ray are referred for DXA measurement of BMD and the figure is even lower in men (less than 20%).

## VERTEBRAL FRACTURES HAVE A SEVERE IMPACT ON PEOPLE AND SOCIETY

- Vertebral fractures lead to severe spinal deformity, back pain, loss of height, immobility, depression, increased number of bed days, reduced pulmonary function and premature death.
- Clinical vertebral fractures are associated with an 8-fold increase in mortality, which is similar to the increase in mortality seen following hip fractures.
- The financial burden of spinal osteoporosis and associated fractures is significant and in the elderly, includes the costs of hospitalisation, subsequent rehabilitation and carers.
- In the working population, medical costs associated with vertebral fractures are related to outpatient care and to the loss of working days.

**1** *new*  
*spinal fracture*  
*every 22 seconds*  
*worldwide*



- In the US there are approximately 2 million osteoporotic fractures each year costing close to 17 billion USD. Vertebral fractures contribute 1 billion towards this cost.
- In Europe, new cases of osteoporotic vertebral fractures were estimated to cost 719 million EUR in year 2000.
- As the number of spinal fractures increase, so do the mortality rates.

### **WHAT HEALTH PROFESSIONALS CAN DO**

- Health care professionals should be aware of and look out for the signs of vertebral fractures: loss of height (more than 3 cm/ just over an inch), sudden severe or chronic back pain, increased spinal deformity or hump.
- Radiographic diagnosis is considered the best way to identify and confirm the presence of vertebral fractures, however vertebral fracture assessment by DXA can also be used.
- Radiologists and other health care professionals should report the findings of vertebral fracture as FRACTURED to avoid ambiguity.
- Effective therapies that reduce the risk of vertebral fractures by 30% - 70% in post-menopausal women are widely available.

# Foreword

Vertebral osteoporotic fractures are common around the world with one in four women over the age of 50 having a vertebral fracture in her remaining lifetime. Vertebral fractures have a major impact on an individual's quality of life, causing pain, height loss, depression and disability. These fractures also lead to significantly increased mortality.

Thus vertebral fractures have a large impact not only on the individual but also on the resources of society and healthcare systems. Yet these fractures remain largely undiagnosed and untreated by health care professionals – estimates are that two-thirds of all vertebral osteoporotic fractures do not come to medical attention.

One vertebral fracture leads to another and another, resulting in the fracture cascade. Moreover, vertebral fractures are powerful predictors of future osteoporotic fractures of all types.

Vertebral fractures that come to clinical attention are associated with an 8-fold increase in mortality, similar to that seen following hip fractures. In individuals who have sustained a vertebral fracture, excess mortality increases progressively following diagnosis and is likely to reflect co-existing co-morbidities, such as impaired pulmonary function. As the number of spinal fractures increase, so to do mortality rates.

Prevention of all osteoporotic fractures is a key public health goal. Diagnosis and early intervention after the first vertebral fracture has occurred would advance this goal and lead to a reduced burden of disease, along with dramatic improvements in quality of life of those who suffer from osteoporosis.

There have been major recent advances in the identification of vertebral fractures by vertebral fracture assessment (VFA) using bone densitometry. Along with spinal radiographs, VFA should be considered by clinicians for use in the early identification of vertebral fractures.

Several signs may indicate that a person has suffered one or more spinal fractures – height loss, increased spinal stoop, acute and/or chronic back pain. These signs should prompt health care professionals to evaluate patients for

vertebral fractures and osteoporosis, so that treatment to prevent future fractures can be started early thus reducing subsequent associated morbidity and mortality.

Our hope is that this report will be read and used by health care professionals, national osteoporosis societies, policy makers, media and consumers around the world, so that prevention of vertebral fractures, with a reduction in the subsequent negative impact on quality of life and health care resources, may become a reality.



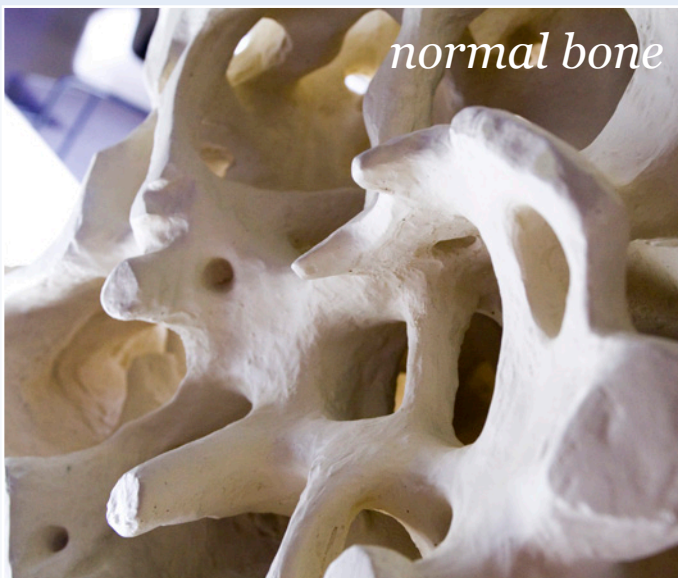
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*normal bone*



*osteoporotic bone*

Osteoporosis is a *disease* characterised by low bone mass and deterioration in the micro-architecture of bone tissue

## About Osteoporosis

Osteoporosis is a disease characterised by low bone mass and deterioration in the micro-architecture of bone tissue, leading to an increased risk of fracture. Osteoporosis occurs when the bone mass decreases more quickly than the body can replace it, leading to a net loss of bone strength. As a result bones become fragile, so that even a slight bump or fall can lead to bone fractures. These are known as fragility fractures. Osteoporosis has no signs or symptoms until a fracture occurs – this is why it is often called a ‘silent disease’.

Osteoporosis affects all bones in the body however fractures occur most frequently in the vertebrae (spine), wrist and hip. Osteoporotic fractures of the pelvis, upper arm and lower leg are also common and are associated with significant disability. Fragile bones are not

painful but the broken bones that result cause pain and increased morbidity and mortality.

### HIP FRACTURES

Hip fractures are the most devastating fracture in terms of morbidity and mortality, as 20% of those who suffer a hip fracture die within 6 months after the fracture. Most hip fractures take place after a fall. The exponential rise in rates of hip fracture with age in both men and women results from both an age-related decrease in bone mass at the proximal femur and the age-related increase in falls.

### VERTEBRAL FRACTURES

Vertebral fractures are the most common osteoporotic fracture. Vertebral fractures are frequently

caused by routine activities such as bending forward, twisting and/or lifting light objects. Falls are also associated with vertebral fractures. The prevalence (the number of fractures at any one time in a community) of vertebral fractures is similar in men and women. In men this is thought to be occupation-associated. However the incidence (number of new fractures) of vertebral fracture is about one-third higher in women than men between 50-60 years, and doubles after age 70.

### WRIST FRACTURES

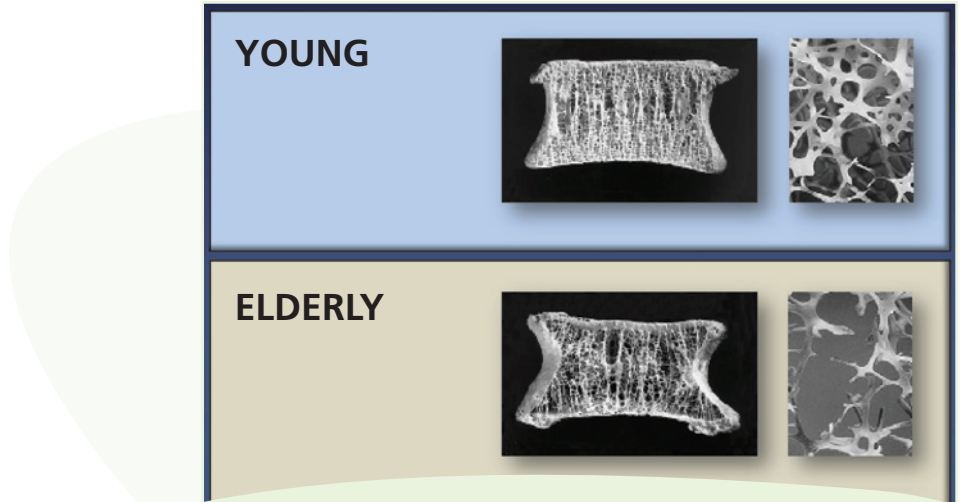
Most wrist fractures happen in women, occurring earlier than hip and vertebral fractures, with the incidence increasing with age. The incidence of wrist fractures in men is low and does not increase with age.

# Pathophysiology of Osteoporosis and Vertebral Fractures

There are two types of bone: cortical (compact) and trabecular (cancellous). Cortical bone comprises approximately 80% of the skeleton and is found in the shafts of long bones (such as the femur or thigh bone) and on the outer surface of flat bones. Trabecular bone is found mainly at the ends of long bones, the inner parts of flat bones, and in the bones of the spine.

Cortical bone consists of compact bone arranged concentrically around central canals containing blood vessels and nerves. Trabecular bone is composed of interconnecting plates and rods within which lies bone marrow.

During the first decades of life, bones grow (i.e., get longer) and get stronger as bone mass increases. Approximately 80% of adult bone mass is acquired during puberty, and optimal peak bone mass depends on adequate nutrition, exercise, and sun exposure, which is needed for the body to produce Vitamin D, which helps the body absorb calcium from our diet. Deficits in nutrition or exercise at this critical time for skeletal health can lead to lifelong deficits in bone strength. Between 20 and 30 yrs of age, peak bone mass is achieved. After this time, the skeleton undergoes a continual, coordinated process of bone breakdown and rebuilding, termed bone remodelling. Bone remodelling is driven by the body's need for calcium and is influenced by a number of hormones and growth factors, and also possibly by the need to repair regions of the bone that have become damaged due to daily use. This coordinated process of bone breakdown and rebuilding allows the skeleton to remain healthy throughout life.



Reproduced from Mosekilde L. (1998) *Tech Health Care*. 6: 287 and courtesy of D. Dempster.

► **FIGURE 1** *Age-related changes in bone microarchitecture*

#### WITH AGEING

- ↓ BONE VOLUME
- ↓ TRABECULAR THICKNESS
- ↓ TRABECULAR NUMBER
- ↓ CONNECTIVITY
- ↓ MECHANICAL STRENGTH
- ↑ CORTICAL POROSITY

With increased age, the balance between bone breakdown (or resorption) and bone building (or formation) tends to get out of balance, with greater resorption than formation. This is likely due to a number of factors, including the decline in sex hormone levels in women and men, insufficient dietary intake of calcium, and/or inadequate vitamin D. This imbalance in bone remodelling leads to progressive bone loss, deterioration of the bones' microstructure, a decline in

bone strength and ultimately an increased risk of fracture. In addition, certain drugs and diseases can cause bone loss and increased skeletal fragility.

The bones of the spine (vertebral body) consist mainly of trabecular bone with an outer layer of cortical bone. Trabecular bone has a large surface area and lies in close proximity to the marrow cells that are involved in the formation and removal of bone. As bone loss initially



*20 – 25% of Caucasian women and men over 50 years having a prevalent vertebral fracture*

starts at the bone surfaces, changes in bone mass occur earlier and to a greater extent, in trabecular bone like the vertebrae, than in areas of the skeleton that are mainly cortical, such as the femur (thigh bone).

Vertebral fractures occur when one of the bones in the spinal column collapses, or fractures. In people who have poor bone strength, these fractures can occur during activities of daily living, such as lifting an object, or turning over in bed, or with

minimal trauma, such as stepping off a curb. Vertebral fractures also occur as a result of falls.

### **A COMMON DISEASE**

Worldwide an osteoporotic fracture occurs every 3 seconds. At 50 years of age, one in two women and one in five men will suffer a fracture in their remaining lifetime. For women this risk is higher than the risk of breast, ovarian and uterine cancer

combined. For men, the risk is higher than the risk for prostate cancer.

In the US there are approximately 2 million fractures annually, including 700,000 vertebral fractures, 400,000 wrist fractures, 300,000 hip fractures, 130,000 pelvic fractures and 680,000 fractures at other sites. Approximately 50% of people with one osteoporotic fracture will have another, with the risk of new fractures rising exponentially with each fracture.

Of particular importance, a vertebral (spinal) fracture occurs every 22 seconds worldwide with 20 – 25% of Caucasian women and men over 50 years having a prevalent vertebral fracture. The occurrence of vertebral fractures increases with age, such that an estimated 50% of women over 80 years has a prevalent vertebral fracture.

Osteoporosis affects approximately 200 million women worldwide

- 1/10 of women aged 60
- 1/5 of women aged 70
- 2/5 of women aged 80
- 2/3 of women aged 90



## Eva Saraiva

### Rio de Janeiro, Brazil

Benedicta Eva Saraiva lives in the Botafogo neighbourhood of Rio de Janeiro. Now 77 years of age, Eva was diagnosed with osteoporosis over a year ago, following a fracture of her femur (hip). Not long after the hip fracture, she suffered a spinal fracture which was extremely painful and greatly reduced her mobility for some time.

Despite the serious situation, Eva did not give up. She found a specialized clinic where she was able to benefit from a targeted physiotherapy programme which helped immensely in her recovery. She currently has a doctor who monitors her treatment of osteoporosis which includes calcium and vitamin D supplementation. Like many older people, Eva must also take medication for other health problems, including high blood pressure, anaemia and a thyroid disorder.

With great perseverance and willpower, Eva is able to carry out many of her routine daily activities – she still washes, irons, sweeps, and cooks for herself and her husband. She also goes to church services and to the supermarket or even just for a leisurely stroll whenever possible, although almost always accompanied by her husband, Francisco. His steady support makes her less fearful of falling on the poorly maintained city sidewalks.

“I cannot carry bags, but I know that walking is an important part of my treatment. The fact that I really enjoy walking helps a lot too,” she said. Eva and her husband don’t have a car, so they often ride the bus around town. “I am as cautious as possible when getting on or off the bus, but I never refrain from doing anything I need or want to do. If I have a handrail and someone to help me, I’ll go anywhere.”

Eva welcomes and supports the initiatives undertaken in Brazil by FENAPCO (National Federation of Osteoporosis Patients Associations). Looking back at these past years of treatment, she concludes that it is very important that people know what osteoporosis is and how to prevent it.

# Osteoporosis

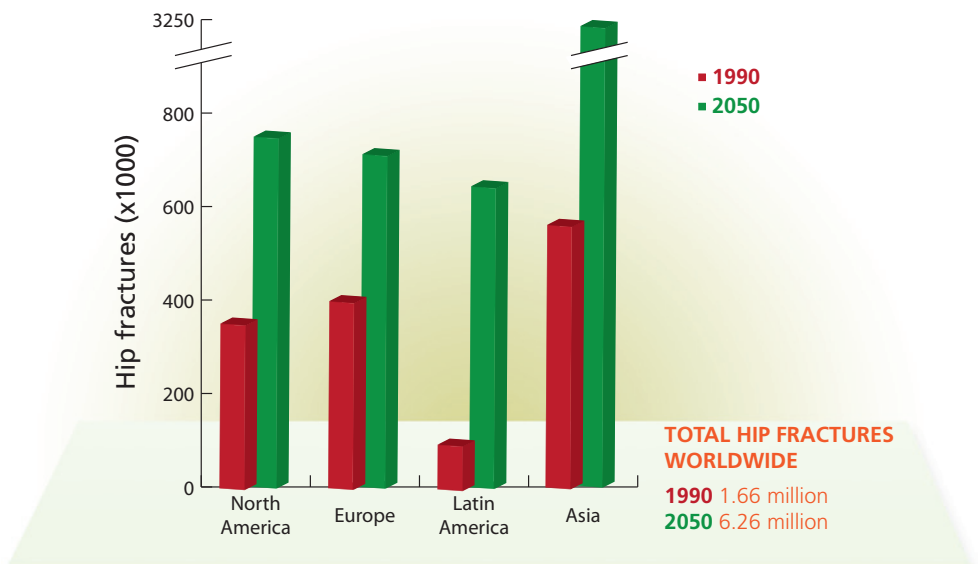
## *A growing public health problem*

With advancing age, bone mineral density (BMD) decreases and the prevalence of osteoporosis increases. The risk of sustaining a fracture increases exponentially with age due not only to the decrease in BMD, but also due to the increased rate of falls among the elderly.

The elderly represent the fastest growing segment of the population. Thus as life expectancy increases for the majority of the world’s population, the financial and human costs associated with osteoporotic fractures will increase exponentially. For example, in Europe the population aged 80 years or more will increase by 160% in women and by 239% in men between 2000 and 2050.

While about half of all hip fractures among elderly people today occur in Europe and North America, this proportion will fall to around one quarter in 2050, by which time steep increases in hip fracture rates will be seen throughout Asia and Latin America. Thus, the greatest increase in the number of osteoporotic fractures is likely to be in the Middle East, Asia, and Latin America, where life expectancy is predicted to increase the most in the coming decades. In Asia, a 7-fold increase in the elderly population is predicted between the years 2000 and 2050. It is estimated that, in Asia and Latin America, the total number of hip fractures will increase more than five-fold between 1990 and 2050.

► **FIGURE 2** Increased burden of osteoporotic fractures worldwide



Adapted from Cooper C et al. (1992) *Osteoporos Int* 2: 285



# Epidemiology

Vertebral (spinal) fractures are the most common fragility fracture and are the hallmark of osteoporosis, occurring in 30-50% of people over the age of 50. It is estimated that one new vertebral fracture occurs every 22 seconds worldwide.

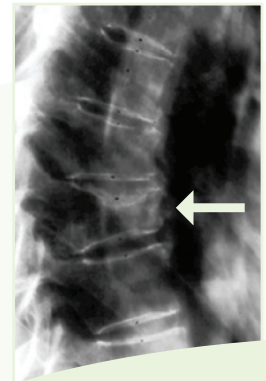
In 2000 there were an estimated 9 million new osteoporotic fractures, of which 1.6 million were at the hip, 1.7 million at the forearm and 1.4 million were clinical vertebral fractures that came to medical attention. In the US alone it is estimated that at least 700,000 vertebral fractures occur each year.

Vertebral fractures are critically important because they are a strong predictor of fracture risk, at any skeletal site, independent of bone mineral density (BMD). The risk of sustaining a new vertebral fracture is several times higher in those who already have a vertebral fracture compared to those with no vertebral fracture. This risk increases

exponentially with the number and severity of prevalent fractures.

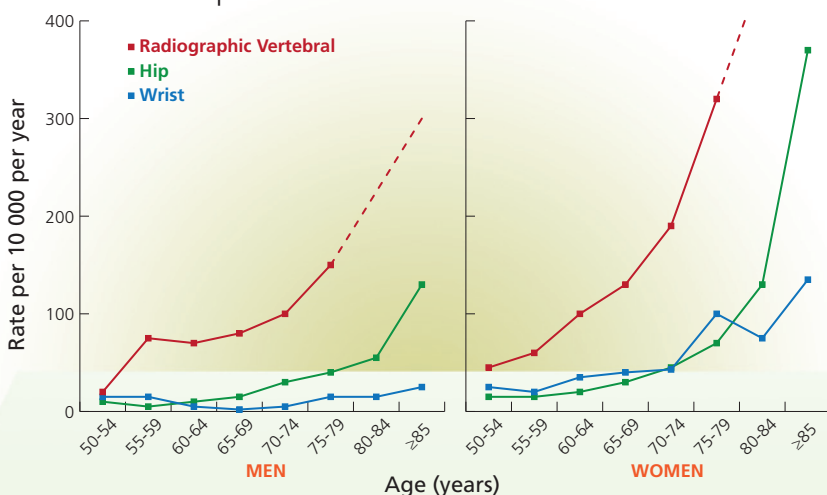
For example, compared to women without vertebral fractures, having two or more prevalent vertebral fractures increases the risk seven-fold of having another vertebral fracture within a year. Of great concern is the high rate of subsequent vertebral fracture following an initial fracture – often referred to as the ‘vertebral fracture cascade’. As many as 20% of women with a prevalent vertebral fracture will suffer a new fracture within a year.

The presence of a vertebral fracture not only increases the risk of new vertebral fractures, but also increases the risk of ANY fracture, including hip fractures. Compared to those without a vertebral fracture, the presence of one vertebral fracture increases the risk of non vertebral fractures by 2 to 3-fold, and that of hip fractures by 2-fold.



- ▶ **FIGURE 3** Vertebral fractures increase the risk of subsequent fragility fractures
- ▶ *Women with vertebral fractures have a 5-fold increased risk of a new vertebral fracture and a 2-fold increased risk of hip fracture*
- ▶ *One woman in five will suffer from another vertebral fracture within a year*

▶ **FIGURE 4** Age-specific and sex-specific incidence of osteoporotic fractures



Adapted from Sambrook P and Cooper C (2006) Lancet 367: 2010

# Morbidity and Mortality

Vertebral fractures lead to significantly increased morbidity and mortality. In fact all osteoporotic fractures increase patient disability, with fractures of the hip and vertebrae associated with increased mortality, in both men and women.

Even a single vertebral fracture can lead to a progressive loss of height, increased kyphosis (stoop), severe and chronic back pain, reduced mobility and reduced pulmonary function.

The psychological impact of vertebral fractures is profound. The loss of mobility, pain and noticeable spinal deformity frequently lead to depression, loss of self-esteem, fear of falling and social isolation.

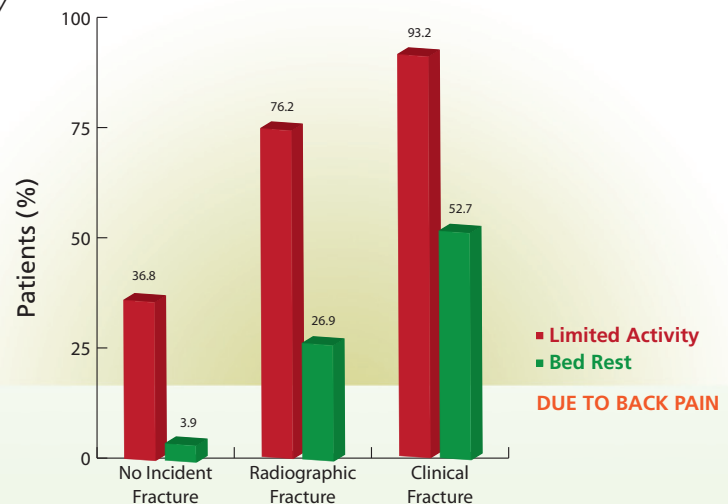
Vertebral fractures are associated with difficulty in many activities of daily living, including forward bending, rising from a chair, dressing and climbing stairs. They lead to a slower walking pace, use of walking aids and decreased independence – all leading to a significant negative impact on quality of life.

People with vertebral fractures are at increased risk of death compared to people of similar age with no vertebral fractures. The increased risk of death is greater in men than women with five-year survival after a vertebral fracture at 72% for men and 84% for women. Long term mortality after a vertebral fracture is similar to the mortality after a hip fracture (8-fold increase) and significantly higher in comparison with the general population.

Following a vertebral fracture, the excess mortality appears to increase progressively after diagnosis of the fracture and is likely to reflect co-existing co-morbidities, such as impaired pulmonary function.

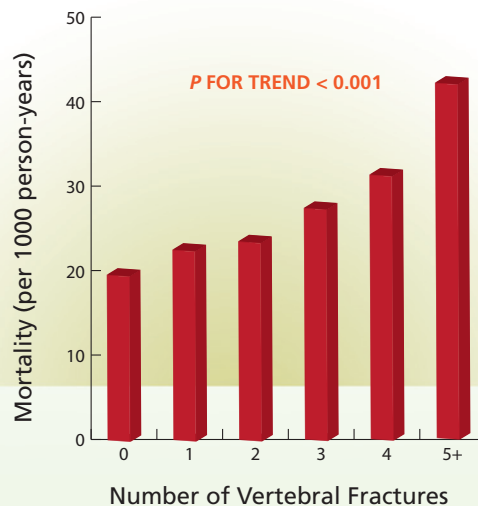
Vertebral fractures are associated with a 16% reduction in expected five year survival.

**FIGURE 5** All types of vertebral fractures are associated with morbidity



Adapted from Nevitt MC et al. (2000) Arch Intern Med 160: 77

**FIGURE 6** Mortality rates by number of prevalent vertebral fractures



Adapted from Kado DM et al. (1999) Arch Intern Med 159: 1215

# Financial Burden

Osteoporotic fractures place a significant burden on society in general and have a huge economic impact. However as so few vertebral fractures are diagnosed and treated, it is difficult to estimate the exact financial burden related to these fractures.

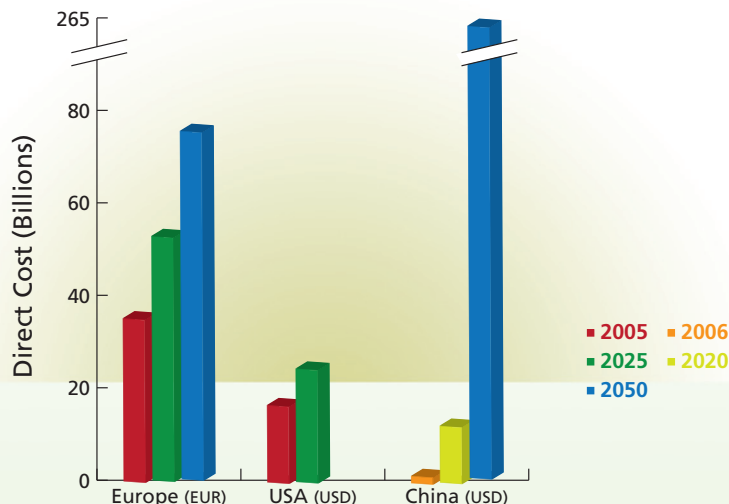
Despite only a minority of vertebral fractures coming to clinical attention, in patients 45 years and over they account for around 52,000 hospital admissions each year in the US and 2,188 in the UK. One third of vertebral fractures need hospitalisation and account for as many hospital bed days as other common medical conditions.

The financial burden of osteoporotic fractures includes direct costs (hospital acute care, in-hospital rehabilitation, outpatient services, long- term nursing care) and indirect costs (morbidity, loss of working days). Some costs are difficult to quantify such as

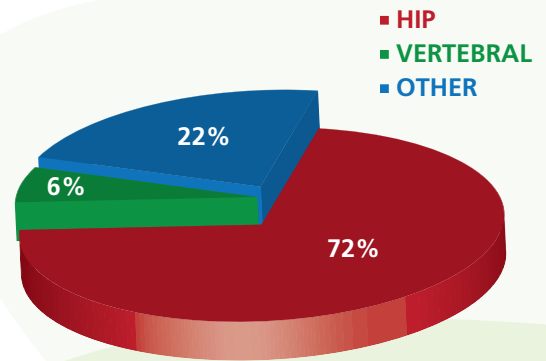
deterioration in quality of life and time spent by family members as carers. Treatment of co-morbid conditions after a fracture constitutes 75% of the overall healthcare cost of osteoporotic fractures.

The costs associated with osteoporotic fractures are predicted to rise markedly in the next 40 years. For example, in Europe, the total direct costs of osteoporotic fractures are over 36 billion EUR annually and are expected to increase to 54 billion and 77 billion EUR in 2025 and 2050 respectively. In the US in 2005, there were over 2 million fractures at a total cost of 17 billion USD. By 2025, the annual number of fractures is projected to increase by 50%, costing over 25 billion USD. In China, 1.5 billion USD was spent on treating hip fractures alone in 2006, with this figure expected to rise to 12.5 billion USD in 2020, and up to 265 billion USD in 2050.

► **FIGURE 8** Projected costs of osteoporotic fractures



Europe: Kanis Ja, Johnell O (2005) Osteoporos Int 16: 229  
 USA: Burge R et al. (2007) J Bone Miner Res 22:465  
 China: Mithal A et al. (2009) The Asian Audit, IOF: 15



► **FIGURE 7** Direct costs of vertebral fractures

- 6% of the total direct cost of osteoporotic fractures, costing 1 billion USD in the US in 2005
- In Europe, the cost was 719 million EUR in 2005

Adapted from Burge R et al. (2007) J Bone Miner Res 22: 465  
 Kanis JA, Johnell O (2005) Osteoporos Int 16: 229



## Raphael Sidler Sursee, Switzerland

Ten years ago, Raphael Sidler, 46, didn't know the meaning of the word osteoporosis. He did not realize that osteoporosis was the insidious cause of multiple fractures and severe back pain dating back to his twenties. At age 33 Raphael felt yet another 'snap' in his back and this time insisted on an MRI. As a result, six vertebral fractures were diagnosed and a subsequent DXA exam confirmed severe osteoporosis. "The diagnosis was tough, but it was a relief to know the cause of years of suffering," he says.

To date Raphael has suffered 11 spinal fractures as well as leg and toe fractures. Several vertebral fractures were spontaneous, others caused by a minor fall, or something as simple as bending over to tie a shoelace. Since his diagnosis, Raphael has been well cared for, receiving weekly physiotherapy, and drug treatment for osteoporosis and pain management. He ensures that his diet is rich in calcium and practices a safe regimen of postural exercises.

Osteoporosis has changed Raphael's life completely. The years of uncertainty, constant pain, and damaged self esteem all helped to contribute to depression. He has had to give up many of the things he loves doing, including bike riding and singing in a choir, and his social life has become more and more restricted. But the most difficult of all was having to give up his work in the family business. Even when feeling relatively well, Raphael must lie down frequently to rest and is physically incapable of working as he used to. Sadly, he says, "Osteoporosis is a disease of restrictions - it makes many things difficult to do and leads to isolation and a lonely life."

As a volunteer for OsteoSwiss, the Swiss patient organization, Raphael continues to make a valuable contribution to society by leading a patient self-help group and sharing his hard won knowledge about the disease. He hopes that by raising awareness of osteoporosis, he will be able to help others.

# Under-detection and Under-diagnosis

Vertebral fractures generally occur earlier in life than hip fractures and thus can be important early indicators of poor skeletal health.

Vertebral fractures are powerful predictors of future spine and hip fractures, so accurate diagnosis and clear reporting of these fractures is essential, yet only about a third of vertebral fractures come to clinical attention. Furthermore, there is considerable evidence that vertebral fractures are under-reported, and when they are reported, appropriate intervention is often not initiated.

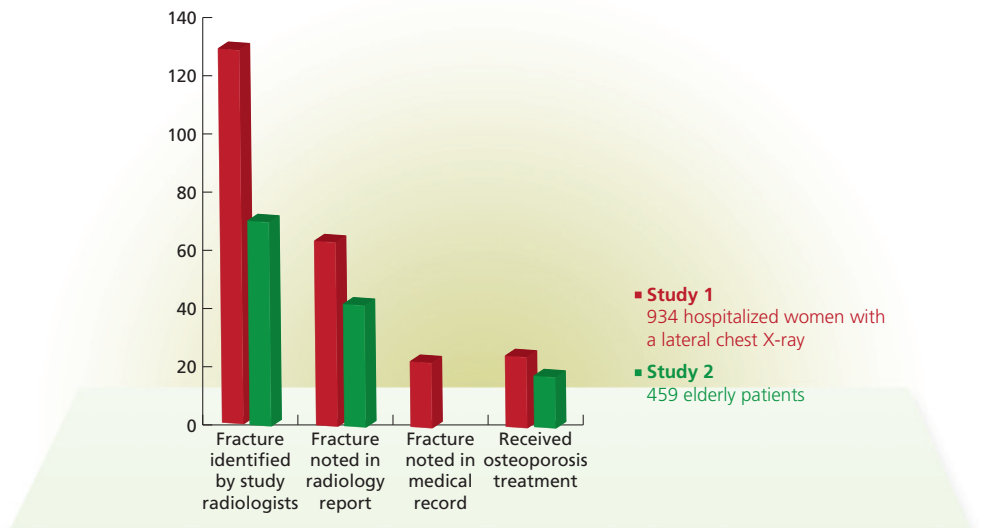
Studies show that vertebral fractures are often not diagnosed such that, only about 30% of vertebral fractures come to medical attention. Most of these (84%) are detected during routine

investigation of back pain and 16% are old fractures detected incidentally during work-up or unrelated investigations.

There are several reasons why so many vertebral fractures do not come to medical attention:

- The occurrence of a spinal or vertebral fracture generally does not require emergency care, unlike hip and other osteoporotic fractures
- The person suspects their sudden back pain maybe due to arthritis, a muscle strain or other causes
- The physician does not recognize height loss, back pain and increased stoop as signs that a fracture has occurred

**FIGURE 9** Under-diagnosed vertebral fractures



Study 1: Gehlbach SH et al. (2000) *Osteoporos Int* 11: 577

Study 2: Majumdar SR et al. (2005) *Arch Intern Med* 165: 905

► *Vertebral fractures are under-diagnosed worldwide*

MISSED DIAGNOSIS OF VERTEBRAL FRACTURE

North America	45.2%
Latin America	46.5%
Europe, South Africa, Australia	29.5%
<b>GLOBAL RATE</b>	<b>34.0%</b>

- Vertebral fractures are not always painful and as a result are not on the radar of the patient or physician
- Some vertebral fractures are of slow onset and therefore difficult to detect

In elderly hospitalized patients who had a lateral chest X-ray, less than 50% of vertebral fractures which were retrospectively identified on these X-rays were reported in the radiological reports and even fewer in the medical records. Only about 40% of older women with vertebral fractures visible on X-ray are referred for DXA measurement of BMD and the figure is even lower (less than 20%) for men. Only one fifth of patients identified with vertebral fractures received appropriate treatment for osteoporosis.

This is despite the fact that:

- There are validated radiologic techniques for diagnosis
- The presence of a vertebral fracture markedly increases the risk for future fractures
- There are effective and safe treatments available
- Evidence based guidelines for diagnosis and management of osteoporosis, including vertebral fractures have been published in most countries

This clearly highlights the need for continuing education of both health care professionals and patients.

Overall, 30-50% of vertebral fractures are misdiagnosed or not mentioned in radiology reports (false negatives), attributable in part to a lack of detection or use of ambiguous terminology by the reporting practitioner (Impact Study 2005). On the other hand, only 5% of vertebral fractures are wrongly diagnosed (false positives).

*Sudden severe back pain may be a sign of vertebral fractures*





## Krishna Delhi, India

Ms. Krishna, aged 62, is a former government civil servant who for years carried out a demanding job at a children's immunization centre. At the age of 55 she sustained her first fracture, breaking her right shoulder. The fracture was treated and subsequently healed, but doctors did not test her for osteoporosis.

Ms Krishna's life took a dramatic turn four years later, when she fractured her hip after a minor fall. This marked the beginning of a long tale of woes. The fracture did not heal correctly and she has suffered extreme pain ever since. Disabled to the point of being almost bedridden, Ms. Krishna was unable to work and consequently lost her job.

She somehow managed to carry on with her family's support. Despite the previous fractures and obvious signs of spinal deformity, doctors still did not diagnose osteoporosis. Gradually Ms. Krishna developed chronic back pain and her back began to stoop. With her negligible financial resources, she had no choice but to bear the pain and cope with an uncertain future.

Ms. Krishna's family contacted the Arthritis Foundation of India Trust (AFI) after reading about the organization in a local newspaper. AFI arranged for testing, determining that Ms Krishna had vertebral fractures and was suffering from severe osteoporosis (with a T-score of less than -3.5 standard deviation). AFI has since provided care, offering free medication, testing and physiotherapy.

Since joining a local support group, Ms Krishna says, "My outlook towards life has changed. I am becoming more and more independent now and am feeling hopeful." She exercises regularly and follows guidelines to reduce fracture risk. Although unable to work, she walks with support and finds happiness in spending time with her granddaughter. Her message to others – "Do not ignore proper calcium intake and adopt a good lifestyle, so that you do not suffer the way I did."

# Signs of Vertebral Fractures

There are several important signs that show that one or more vertebral fractures may have occurred:

- Loss of height (more than 3 cm/ just over an inch)
- Sudden severe back pain in the mid and lower spine
- Increased stoop or 'dowager's hump'

All health care professionals involved in the care of people with osteoporosis should be aware of these signs, particularly in their patients over 50 years of age.



► **FIGURE 9** *Clinical consequences: reduced independence and quality of life*

- KYPHOSIS
- LOSS OF HEIGHT
- BULGING ABDOMEN
- ACUTE AND CHRONIC BACK PAIN
- BREATHING DIFFICULTIES
- DEPRESSION
- REFLUX AND OTHER GI SYMPTOMS
- LIMITATION OF SPINE MOBILITY (DIFFICULTY IN BENDING, RISING, DRESSING, CLIMBING STAIRS)
- NEED TO USE A WALKING AID

# Identification

Clinical guidelines developed by the International Osteoporosis Foundation and other osteoporosis societies around the world recognize the importance of vertebral fractures, along with low BMD, as key risk factors for use in patient evaluation. However, while BMD measured by DXA is widely used in patient evaluation, radiologic assessment of vertebral fractures is not commonly performed, or if performed, is

inadequately standardized and interpreted.

A lateral spine radiograph (X-ray) is the best investigation to confirm the presence of spinal fractures in clinical practice. Early radiographic diagnosis followed by appropriate therapy will help prevent further fractures.

Recent advances in DXA technology allow for vertebral fracture assessment (VFA) at the time of a bone densitometry test. It is

warranted if the results of the test would reasonably influence therapeutic choices to reduce fracture risk. Follow-up imaging with radiography or computed tomography is advisable if substantial numbers of vertebrae are not evaluable, if the presence of deformity is uncertain, if abnormalities are potentially due to malignancy, or if deformities are noted in a person with a history of relevant malignancy.

## ► FIGURE 10 SEMI-QUANTITATIVE VISUAL GRADING OF VERTEBRAL FRACTURES

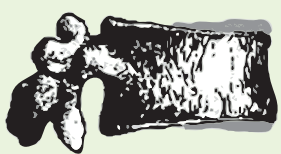
### ► *Grade 0*

Normal, unfractured vertebra



### ► *Grade 1*

Mild fracture with 20-25% reduction in anterior, middle or posterior heights relative to the same adjacent vertebrae



### ► *Grade 2*

Moderate fracture with 25-40% reduction in anterior, middle or posterior heights relative to the same adjacent vertebrae



### ► *Grade 3*

Severe fracture with >40% reduction in anterior, middle or posterior heights relative to the same adjacent vertebrae

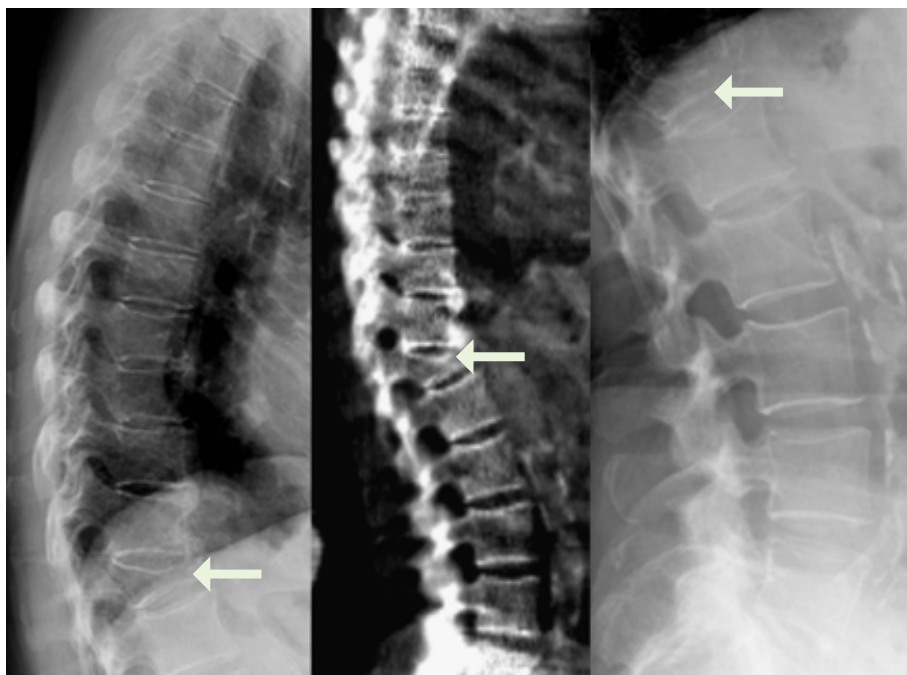


'Genant SQ scoring' adapted from Genant, et. al., JBMR 1993

## TYPES OF VERTEBRAL FRACTURES

Spinal osteoporotic fractures usually occur in the mid (thoracic area) or lower spine (lumbar area). The bones in the spine affected by osteoporosis can become wedged or compressed due to their reduced strength. Depending on how the bone is affected it may be referred to as a 'crush', 'wedge' or 'collapse' fracture. Although spinal bones do heal, they usually do not return to their previous shape. This can lead to a number of obvious spinal changes.

- If a number of 'wedge' fractures occur together then the spine can tip forward leading to an increased stoop or 'dowager's hump'.
- If a number of 'wedge' or 'crush' fractures occur, the spine can shorten leading to height loss.



► **FIGURE 11**

Severe vertebral fracture of T12 on VFA thoraco-lumbar spine image (center) and radiographs of thoracic spine (left) and lumbar spine (right).

## IDENTIFICATION OF VERTEBRAL FRACTURES

### ► *Key Points*

- Currently many mild and some moderate vertebral fractures are often not being recognised and reported, leading to under-diagnosis and under-treatment
- A radiographic diagnosis is considered the best way to identify and confirm the presence of vertebral fractures in clinical practice
- State-of-the-art DXA-based Vertebral Fracture Assessment (VFA) is nearly as accurate as radiographs in detecting fractured vertebra
- DXA-BMD can be performed to diagnose osteoporosis and DXA-VFA can be performed to detect vertebral fractures at the same clinical visit
- All vertebral fractures identified should be reported as FRACTURED to avoid ambiguity caused by other terminology
- Early radiographic diagnosis followed by appropriate therapy will help prevent subsequent fractures



# Treatment and Management

## DRUG THERAPY

Effective therapies (anti-resorptive and anabolic agents) are widely available and can reduce new vertebral fractures by 30% to 70% in postmenopausal women. Similar efficacy is observed in men. These treatments should be taken with adequate supplementation with calcium and vitamin D. Appropriate medications should always be discussed with a doctor. The following therapies have been shown to be effective in the treatment of vertebral fractures:

- alendronate
- denosumab
- ibandronate
- parathyroid hormone
- raloxifene
- risedronate
- strontium ranelate
- zoledronate

The availability of these medications varies between countries and regions.

*Effective therapy can reduce the risk of vertebral fractures by 30-70%*

## MANAGEMENT OF SYMPTOMATIC VERTEBRAL FRACTURES

For people who experience a spinal fracture, their doctor may also recommend the following:

- pain relief with anti-inflammatory and pain medications;
- short-term bed rest in cases of severe pain (patients should begin mobilizing as soon as possible within the limits of their pain);
- abdominal bracing exercises;
- physiotherapy – postural exercise program, muscle strengthening and falls prevention program, hydrotherapy;
- local steroid injections;
- vertebral augmentation with vertebroplasty or kyphoplasty.





## Youssef Eid al-Hawamdeh *Amman, Jordan*

Dr. Youssef Hawamdeh, a 59 year old pharmacist, can consider himself to be a fortunate man. Despite suffering vertebral fractures in a fall at age 55, he has been able to resume his regular daily routine with no long-term impact on his quality of life. "I will never allow osteoporosis to change my life," he says.

Unlike many sufferers, Youssef has not gone on to experience further fractures and the terrible impact of what is termed the 'fracture cascade'. This positive outcome can be attributed in part to the prompt diagnosis and treatment that he received following the accident. Suffering severe pain and bruising, Youssef was immediately admitted to hospital for three days where he underwent extensive testing. Doctors discovered that he had suffered vertebral crush fractures and had bone density loss. After two weeks of bed rest and pain management he was largely able to resume normal activities.

Since the diagnosis, Youssef has strictly adhered to his doctor's prescribed medication for osteoporosis, which includes calcium and vitamin D supplementation. He is vigilant about his movements - avoids heavy lifting and careful when bending. Yet otherwise, his daily activities have not changed. He still swims regularly, plays with his grandchildren and puts in a full day's work at the pharmacy. As a practicing Muslim, he is still able to kneel in prayer.

Asked about his risk for osteoporosis, Youssef said, "I do not know how I got this disease." He reports no family history of osteoporosis or any other risk factors.

One positive effect of the diagnosis was that he shed some extra weight at his doctor's recommendation and he feels much better today because of that. With a laugh he also notes another benefit - "I didn't ask for sympathy, but my family makes sure they do not strain me in any way, and I don't have to help with the washing up."

### TREATMENT OF SYMPTOMATIC VERTEBRAL FRACTURES

- ▶ *Bed rest (in the case of severe pain)*
- ▶ *Pharmacological treatment*
  - *analgesics*
  - *opioids*
- ▶ *Physical therapy*
- ▶ *Bracing*
- ▶ *Local steroid injections*
- ▶ *Vertebral augmentation*
  - *vertebroplasty*
  - *kypoplasty*

### REHABILITATION & PAIN MANAGEMENT

For those suffering from severe spinal osteoporosis, a rehabilitation program may be recommended. Regardless of whether this is an inpatient program or an outpatient program, it is important to always exercise under the supervision of a physiotherapist (or other appropriate health care professional) to reduce the risk of injury and falling.

The pain from spinal fractures is often short-term (6-8 weeks) and usually resolves as the fracture heals. However, permanent changes to posture from several vertebral osteoporotic fractures can lead to severe chronic pain.

For people with multiple crush fractures pain relief medications given in combination with Transcutaneous Electro Nerve Stimulation (TENS; a common

treatment administered by physiotherapists using electrical nerve stimulation) and relaxation techniques have been shown to be effective.

A physiotherapist will often also prescribe a specific back and abdominal strengthening exercise program. Strengthening back extensor muscles has been shown to help reduce the risk of future vertebral fractures.

Additionally, hydrotherapy can be useful for rehabilitation following fractures. The warmth and buoyancy of the water makes slow, gentle movements easier and is also a good place to start a general strengthening program.

It is important to avoid activities that involve bending forward from the waist, especially whilst carrying objects because it increases the risk of vertebral fractures.

# Surgical Options

Some previous studies have found that medical management of symptomatic vertebral fractures often fails to improve pain and mobility particularly in cases of chronic pain related to spinal deformity.

Minimally invasive procedures for vertebral compression fractures that fail to respond to conventional medical therapy, in particular pain relief are available in many countries.

## VERTEBROPLASTY (VP)

VP aims to relieve pain and prevent further collapse of the vertebrae. It is usually performed by interventional radiologists or orthopaedic surgeons using imaging guidance. The collapsed vertebrae is stabilized with the injection of bone cement into the vertebral body. This can reduce pain, and help prevent height loss and spinal kyphosis (stoop) commonly seen as a result of several spinal osteoporotic fractures.

## BALLOON KYPHOPLASTY (BKP)

BKP aims to relieve pain, stabilize the fracture, restore lost vertebral body height, and correct and prevent progression of kyphotic deformity. The procedure involves the insertion of two inflatable bone tamps (balloons) into the vertebrae. After inflation, the balloon creates a cavity that is filled with bone cement. The creation of this cavity is thought to decrease the risk of cement leakage.

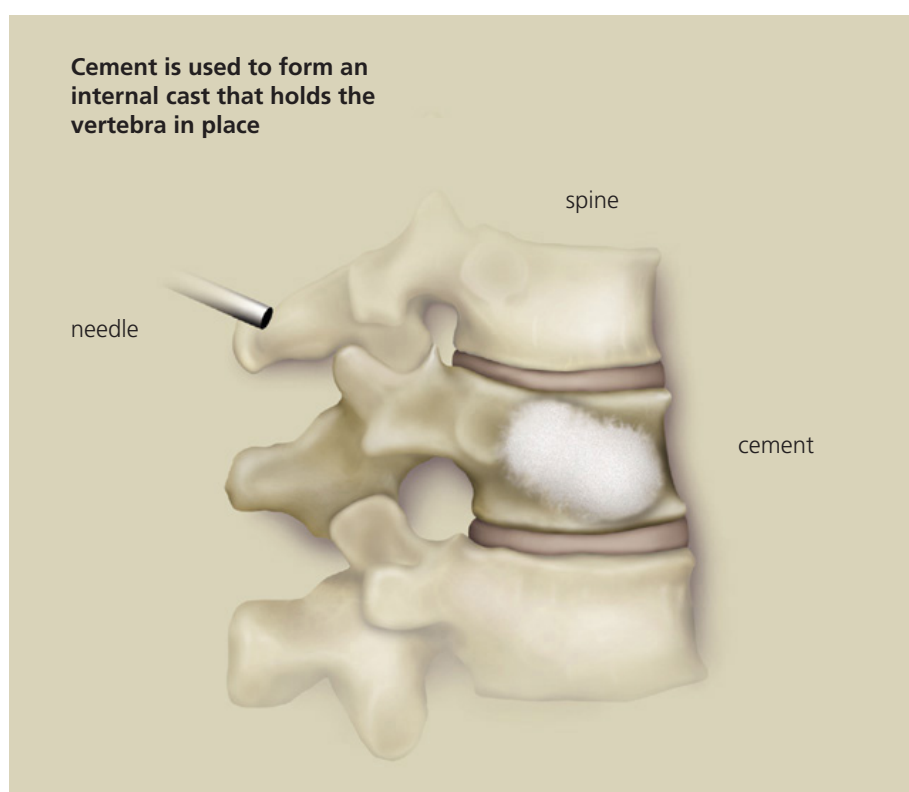
Overall, VP and BKP are relatively safe procedures that can permit quicker pain relief, recovery of mobility and in some cases

vertebral height restoration than conventional conservative medical treatment. However, the long term benefits of these techniques have not been clearly demonstrated. Further prospective randomized controlled studies are needed to assess long-term effects and safety/ complications.

Physicians should be aware of these existing techniques, which have the potential to improve the quality of life of people with

vertebral fractures. However, VP or BKP cannot be substituted for appropriate medical management of osteoporosis in patients with fragility fractures, where the future risk of subsequent fractures must be evaluated individually, and each patient treated according to the importance of that risk. These procedures do not reduce the risk of future fractures and so drug therapy is still required.

## ► FIGURE 12 MINIMALLY INVASIVE PROCEDURE FOR VERTEBRAL FRACTURES



*Courtesy of Kyphon images*



## Salima Ladak-Kachra

Toronto, Canada

At only 25, Salima Ladak-Kachra sustained four vertebral fractures after slipping and falling on a ceramic floor. “The excruciating pain and emotional distress that I endured is something that I do not want others to go through,” says Salima. A DXA scan later revealed severe osteopenia in both the spine and femur as well as old healing vertebral fractures.

Salima recalls her long recovery. “I went through severe pain, and was not able to walk, shower, eat or dress without assistance... In the months that followed, I lost one inch in height and my waist size increased...” Constantly sleepy from the pain killers and with constant pain in her back, she had trouble performing daily tasks and began to suffer both physically and emotionally – putting a strain on her marriage.

Prior to the fall, Salima had seen a few physicians complaining of back pain, but, probably due to her young age, she was not checked for osteoporosis. In retrospect, risk factors would have been apparent: Both parents suffer from the disease, and she had a low BMI and a history of poor calcium intake and little exercise in her youth.

Today Salima still copes with back pain on a daily basis, and has difficulty bending or sitting without support or for prolonged periods. Yet she has taken a proactive role in her recovery, ensuring adequate calcium and vitamin D intake, following a targeted exercise regimen, and increasing her BMI. She uses proper techniques in bending and sitting, refrains from heavy lifting, and receives help with chores when necessary.

As a result of her own devastating experience, Salima now dedicates her life to bone health advocacy. She is co-founder of The Bone Wellness Centre, a health facility which supports awareness, prevention and diagnosis of osteoporosis.

## Prevention Strategies

Managing osteoporosis and preventing fractures is vitally important. Bone health can be better maintained over a lifetime by attention to these key prevention strategies:

- Adequate calcium – ensure you are getting the recommended daily intake of calcium through food and/or supplementation
- Adequate vitamin D, though safe expose to sunlight. Individuals who are vitamin D deficient should also consider supplementation
- Bone-friendly exercises (weight-bearing, strengthening, balance-coordination). For vertebral fractures, strengthening the back extensor muscles is important
- Awareness of personal risk: High-risk individuals (family history, smoker, corticosteroid use, rheumatoid arthritis) should be assessed for fracture risk and for any prevalent fractures

For people in need of treatment, appropriate pharmacological therapies are widely available and include anti-resorptive and anabolic agents previously mentioned on page 17. Pharmacological therapy can reduce the risk of vertebral fractures by 30%-70%.

**REMEMBER**  
*osteoporosis  
is treatable &  
fractures are  
preventable*



# Don't miss the signs of a breaking spine

## TIPS FOR CLINICIANS AND OTHER HEALTH CARE PROFESSIONALS

- ▶ **Evaluate your patients over 50 years of age, particularly those with known risk factors for osteoporosis, and look for:**
  - Loss of height (more than 3 cm / just over an inch)
  - Sudden severe back pain in the mid and lower spine
  - Increased stoop or 'dowager's hump'
- ▶ Do a baseline height measurement of your patients and do yearly comparisons
- ▶ Consider using lateral DXA (or VFA) to identify vertebral fractures
- ▶ Use lateral spinal x-rays to confirm vertebral fractures
- ▶ Initiate treatment for people with prevalent vertebral fractures with appropriate therapy to prevent further fractures

## TIPS FOR PHYSIOTHERAPISTS

- ▶ Prescribe postural exercises and abdominal bracing for your spinal osteoporosis patients
- ▶ Consider appropriate exercise to help relieve the pain and some of the symptoms of increased kyphosis and other postural changes
- ▶ Be aware of the signs that another vertebral fracture may have occurred (as listed above) and do a baseline height measurement
- ▶ Use pain management techniques in the acute phase –TENS, hydrotherapy, gentle strengthening exercise program (include spinal strengthening exercises)
- ▶ Consider Tai Chi programs that can be useful for gentle muscle strengthening, and for improving balance and coordination
- ▶ Advise your patients to avoid;
  - bending forward from the waist
  - sudden, abrupt movements
  - jumping, jarring and twisting movements
  - high-intensity exercise

## TIPS FOR RADIOLOGISTS

- ▶ Recognize the importance of the identification of vertebral fractures using radiography, DXA-based VFA and other spinal imaging techniques
- ▶ Report all osteoporotic fractures as **FRACTURED** to avoid ambiguity
- ▶ Give grades of fractures (mild, moderate, severe)
- ▶ Indicate if the vertebral fracture is osteoporotic, traumatic or pathological & suggest further appropriate imaging, if relevant
- ▶ If the change in vertebral shape is not due to a fracture, use the term 'deformity' and suggest cause (e.g. congenital anomaly)
- ▶ Give number of fractures

## Patient Checklist

These actions will help patients receive effective treatment earlier and prevent subsequent fractures

- ▶ *Have you lost height (more than 3 cm - just over 1 in)?*
- ▶ *Have you had sudden, severe back pain in recent times?*
- ▶ *Have you noticed an increased stoop in your spine?*
- ▶ *Do you have a family history of osteoporosis?*
- ▶ *Do you have frequent falls?*

## REPORT

*any of the above to your doctor and discuss treatment options*

# About IOF

The International Osteoporosis Foundation (IOF) is a not for profit, nongovernmental umbrella organization dedicated to the worldwide fight against osteoporosis, the disease known as “the silent epidemic”. IOF’s members – committees of scientific researchers, patient, medical and research societies and industry representatives from around the world – share a common vision of a world without osteoporotic fractures. IOF now represents 195 societies in 92 locations around the world.

<http://www.iofbonehealth.org>

## Glossary

<b>FRACTURE</b>	break/broken bone
<b>INCIDENCE</b>	number of new fractures in a given population in one year
<b>PREVALENCE</b>	number of people who have a fracture at a defined point in time
<b>MORBIDITY</b>	reduced health quality
<b>MORTALITY</b>	death
<b>VERTEBRA</b>	individual bone of the spine
<b>FEMUR</b>	hip bone
<b>DXA</b>	dual-energy X-ray absorptiometry (instrument used to measure bone mineral density)
<b>BMD</b>	bone mineral density (how much calcium per unit size is in the bone)
<b>PULMONARY</b>	to do with lungs/respiratory system
<b>MICRO-ARCHITECTURE</b>	the scaffolding structure of bone that gives it strength

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**FOR A COMPLETE LIST OF REFERENCES VISIT [WWW.IOFBONEHEALTH.ORG](http://WWW.IOFBONEHEALTH.ORG)**

*“IOF urges everyone to be on the alert for possible signs of osteoporotic spinal fractures - height-loss, back pain and increased stoop.”*

**PROF CYRUS COOPER**  
Chair of the Committee of  
Scientific Advisors, IOF

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