Bone Science and Osteoporosis

LECTURE 2

Learning Objectives

- Bone Cells and Bone Formation.
- Two Types of Bone.
- Skeletal system life cycle.
- What is Osteoporosis and Low bone Density.
- How bone loss occurs.
- What causes bone loss.
- Common types of Osteoporotic fractures.

Bone as Material

Over a few centuries, bone structure and function has been discussed and studied however, significant findings did not occur until the late 1600s starting with Leeuwenhoeck (1674) who was the first to publish observations of osteons (building blocks of bone) at the microscopic level.

Landmark findings included the concept that bone is formed and resorbed throughout life (Munro, 1776), the finding that the surrounding muscles determine the form of bone (Fick, 1856) and the statement that there is a relationship between function and structure of bone (Von Meyer, 1867).

It is this theme of the related structure and function that guided the research in the next century with important discoveries and theories such as proposed laws by Wolff (1870) that summarize an interdependence between form and function of bone, and the proposal by Roux (1883) that the orientation of bone trabecula corresponds to the direction of tension/compression which is an example of how bone architecture follows engineering principles.

Bone is a living tissue composed of a protein matrix which is osteocollagenous and minerals (calcium salts). Twenty percent of the bone is water, while the matrix and salts contribute 35% and 45% respectively. Bone can be classified as cancellous (otherwise known as trabecular) or cortical (compact) which do not differ greatly biomechanically despite their differing density and porosity.

Mechanical Behavior of Bone

You can certainly imagine that your daily activities result in all kinds of forces placed on the body – every change of position result in some type of force being transmitted through your bones and joints.

Therefore, bones are subjected to compressive, tensile and shear stresses daily. Occasionally external forces are applied to our bones which are excessive, take for example being hit on the leg by a taxi while trying to cross the street. This could result in a bending load being applied to your tibia.

As mentioned briefly above, the strength of bone is affected by both age and geometry. During the aging process, bone tissue is resorbed from the endosteal surface and then laid down on the periosteal surface which leads to thinner bones with a larger diameter. While a thinner bone would be more likely to break, the increase in cross-sectional size can partly compensate for this.

Why is this? First, the bending strength of a rod varies as the cube of the radius of the rod changes. Therefore, a change in radius by as little as 1mm can increase the strength by 33%. However, if bones were a solid rod, it would be very strong but too heavy to move. The compromise? Hollow bones with a reasonable diameter.

Bone Cells and Bone Formation

Bone Formation or Ossification: Is the process that produces new bone tissue.

Bone tissue replaces a precursor embryonic tissue to form the skeleton.

The Process of ossification is used throughout life to remodel bones.

Two methods of bone formation:

- Intramembranous: happens in the Skull and Clavicle
- Endochondral: Happens in the rest of the skeleton

Intramembranous Ossification

Occurs on or within fibrous connective tissue membranes.

Ossification centers form when Embryonic mesenchyme cells change to osteogenic cells and then osteoblasts.

Osteoblast begin to secret osteoid (bone matrix) and become osteocytes.

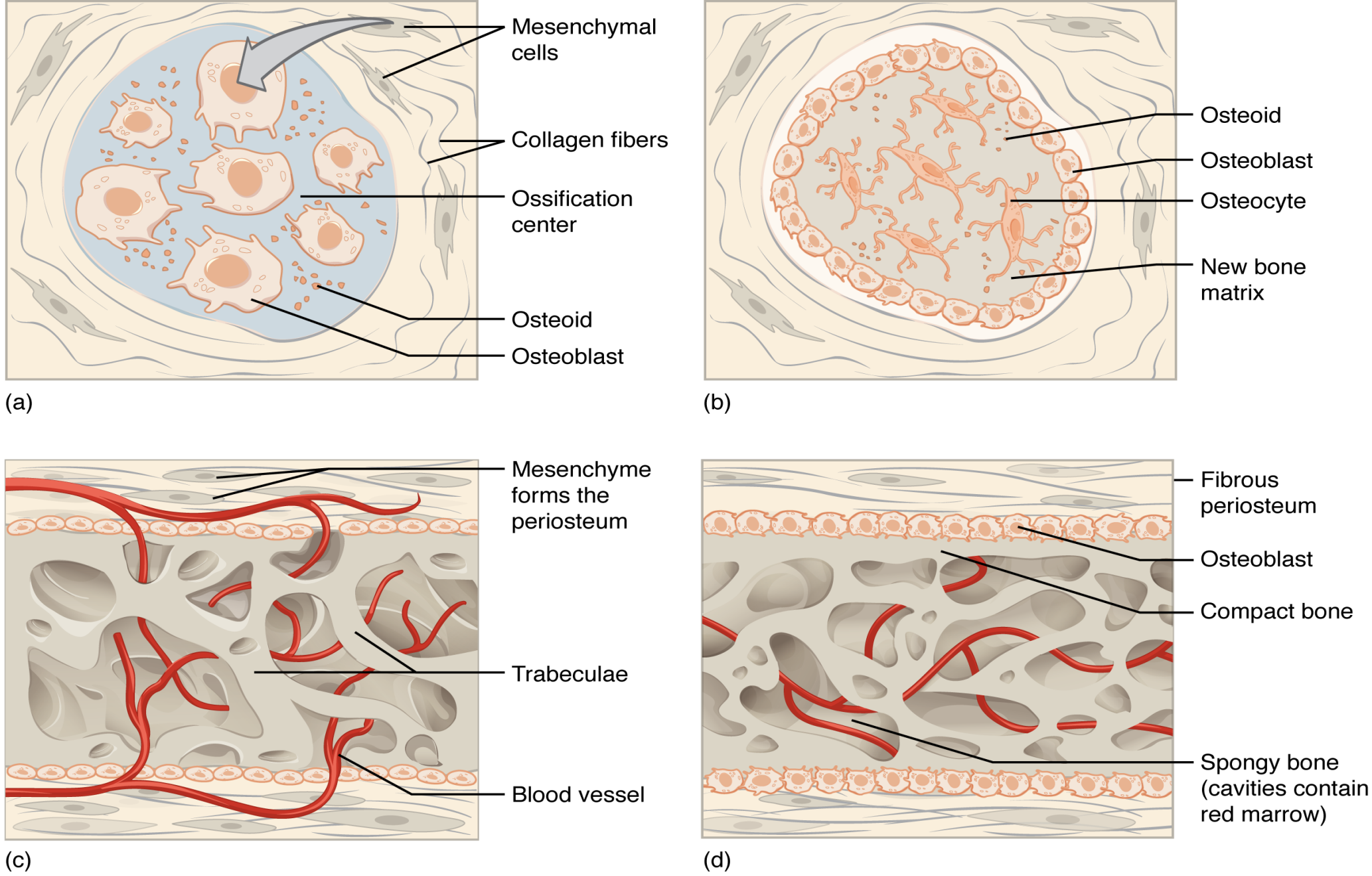
Osteocytes are bone maintenance cells that promote deposition of calcium salts. Hardening a matrix.

The bone matrix develops thin columns of bone called **trabeculae** that fuse to create spongy bone.

Intramembranous Ossification Continued

Outside of the bone a layer of connective tissue called periosteum forms.

Compact bone then replaces the outer layer of spongy bone creating **compact bone**.



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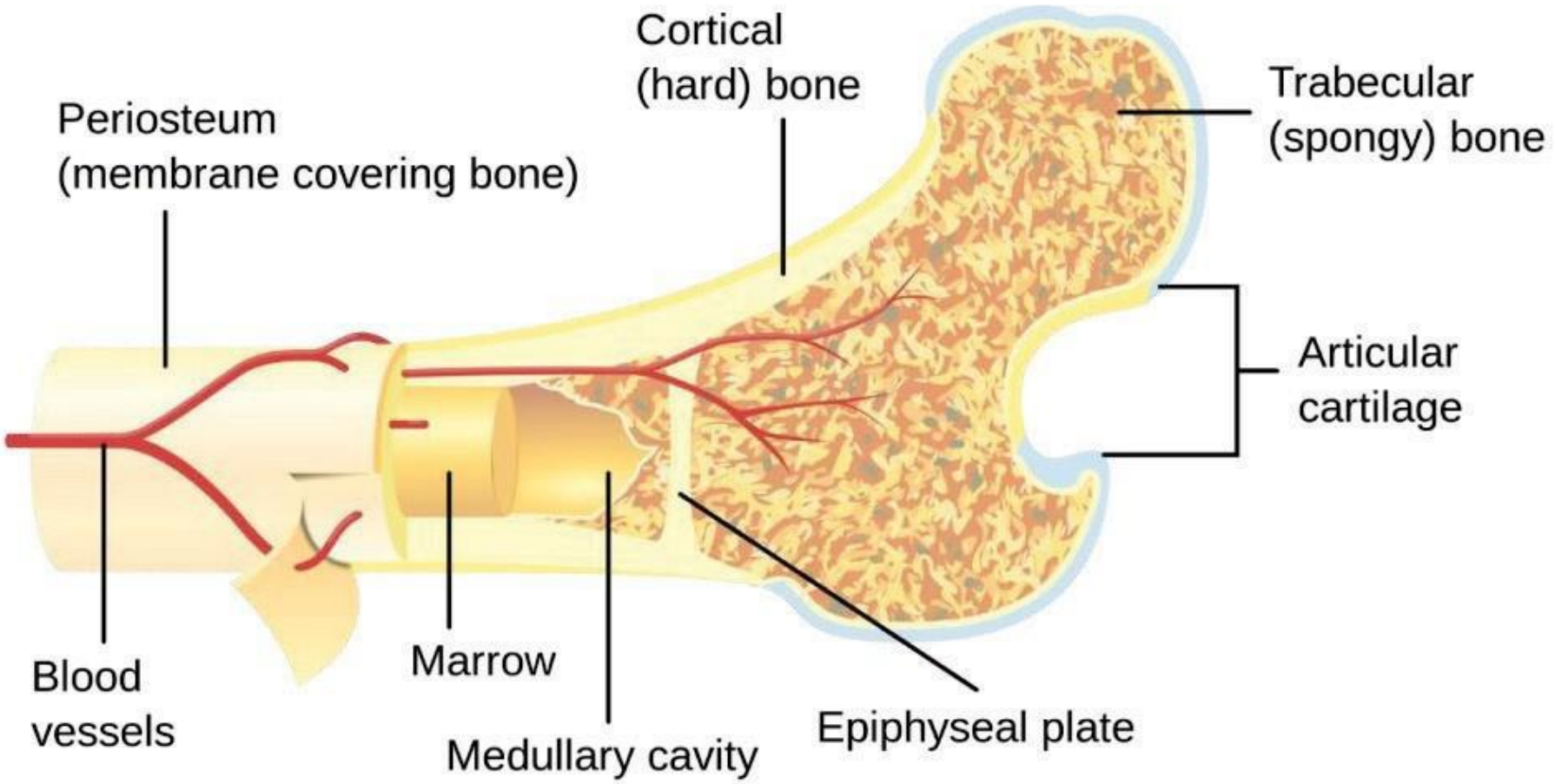

Periosteum
(membrane covering bone)
Cortical
(hard) bone
Trabecular
(spongy) bone
Articular
cartilage
Blood
vessels
Marrow
Medullary cavity
Epiphyseal plate

Endochondral Ossification

The replacement of cartilage with bone.

Formation of cartilage model

- Embryonic mesenchyme cells condense and turn into chondroblasts.
- Chondroblasts begin secreting cartilage matrix to form the cartilage model.
- Perichondrium forms around the cartilage.
- A nutrient artery penetrates the perichondrium.
- Osteogenic cells develop into osteoblast.
- The Osteoblasts deposit bone matrix to form a thin shell of compact bone known as bone collar.
- Once the perichondrium starts to form bone it is known as the periosteum.

Endochondral Ossification continued

Primary ossification center formation:

- Bone Collar deprives nutrients to cartilage at the model's interior.
- Osteoblast carrying capillaries grow into the disintegrating cartilage.
- The primary ossification center is where osteoblasts form bone matrix, replacing cartilage matrix.
- Osteoblast secrete bone matrix, Building spongy bone trabeculae.
- The medullary cavity forms at the core of the cartilage model.
- Cavity fills with capillaries and red bone marrow.
- Ossification proceeds forming the bony diaphysis.

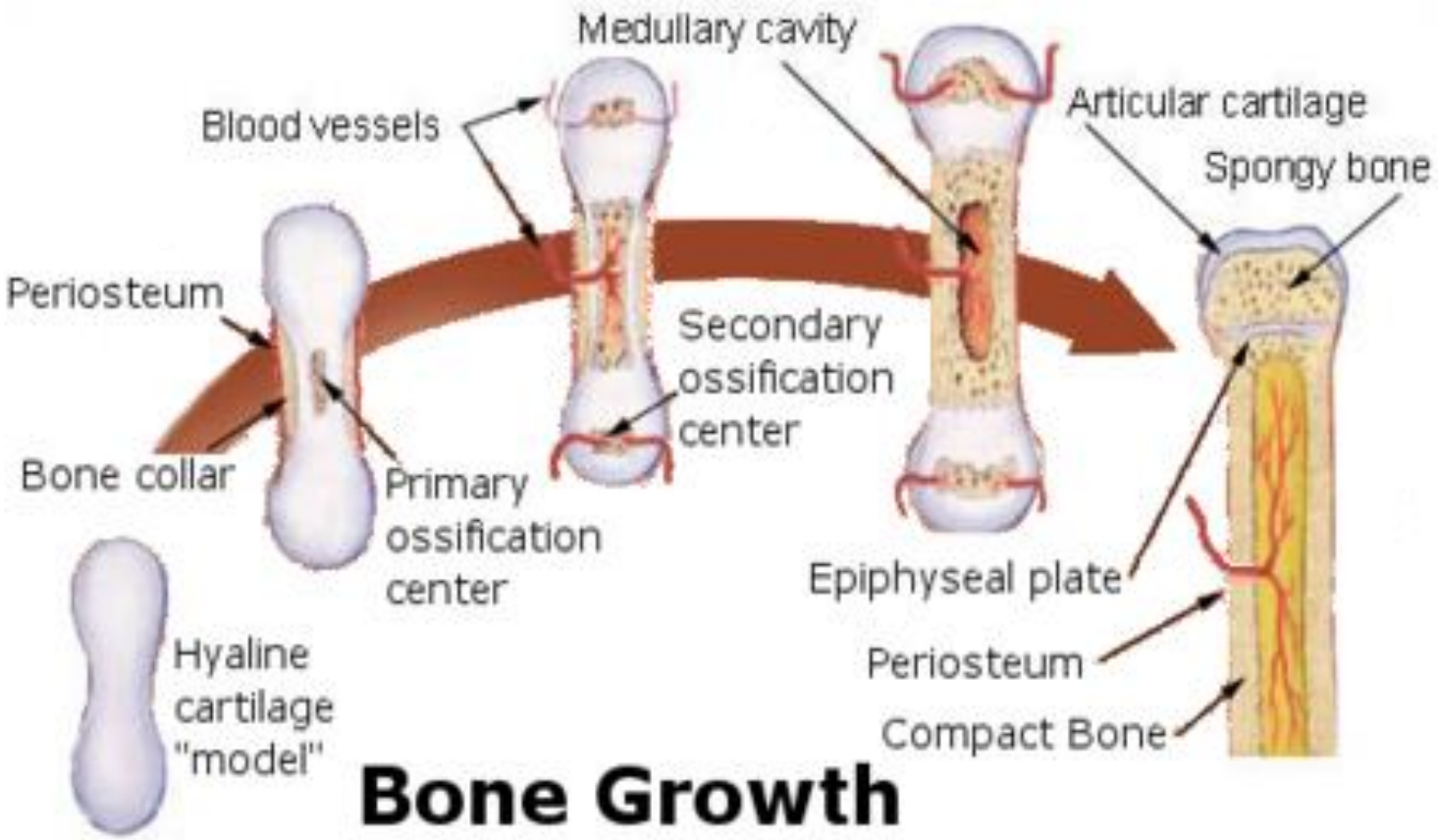


Image from: https://en.wikipedia.org/wiki/Endochondral_ossification

Secondary Ossification Center Formation

Blood vessels enter the cartilaginous epiphysis forming secondary ossification centers.

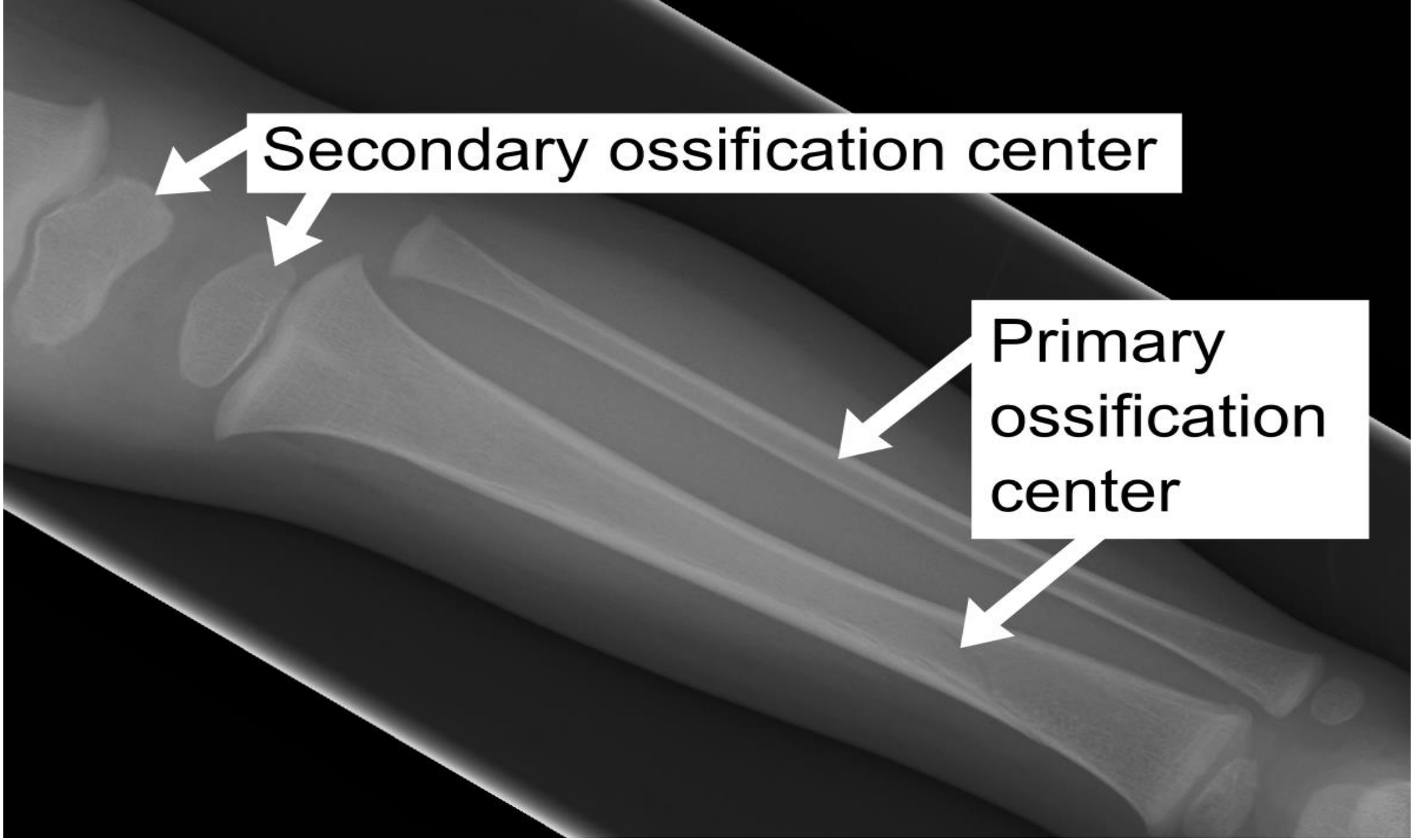
Ossification proceeds outward, no medullary cavity forms.

As a result, the interior of the epiphysis remains spongy.

The Epiphyseal plate consists of hyaline cartilage and enables the diaphysis to grow in length.

In the end of all this formation we end up with two types of bone:

- Trabecular bone: Soft spongy bone.
- Compact bone: Harder outer bone.



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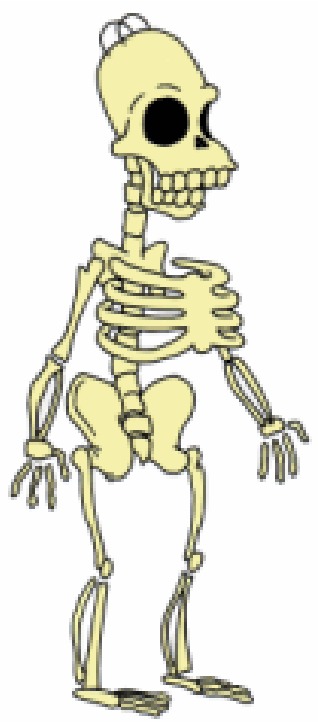
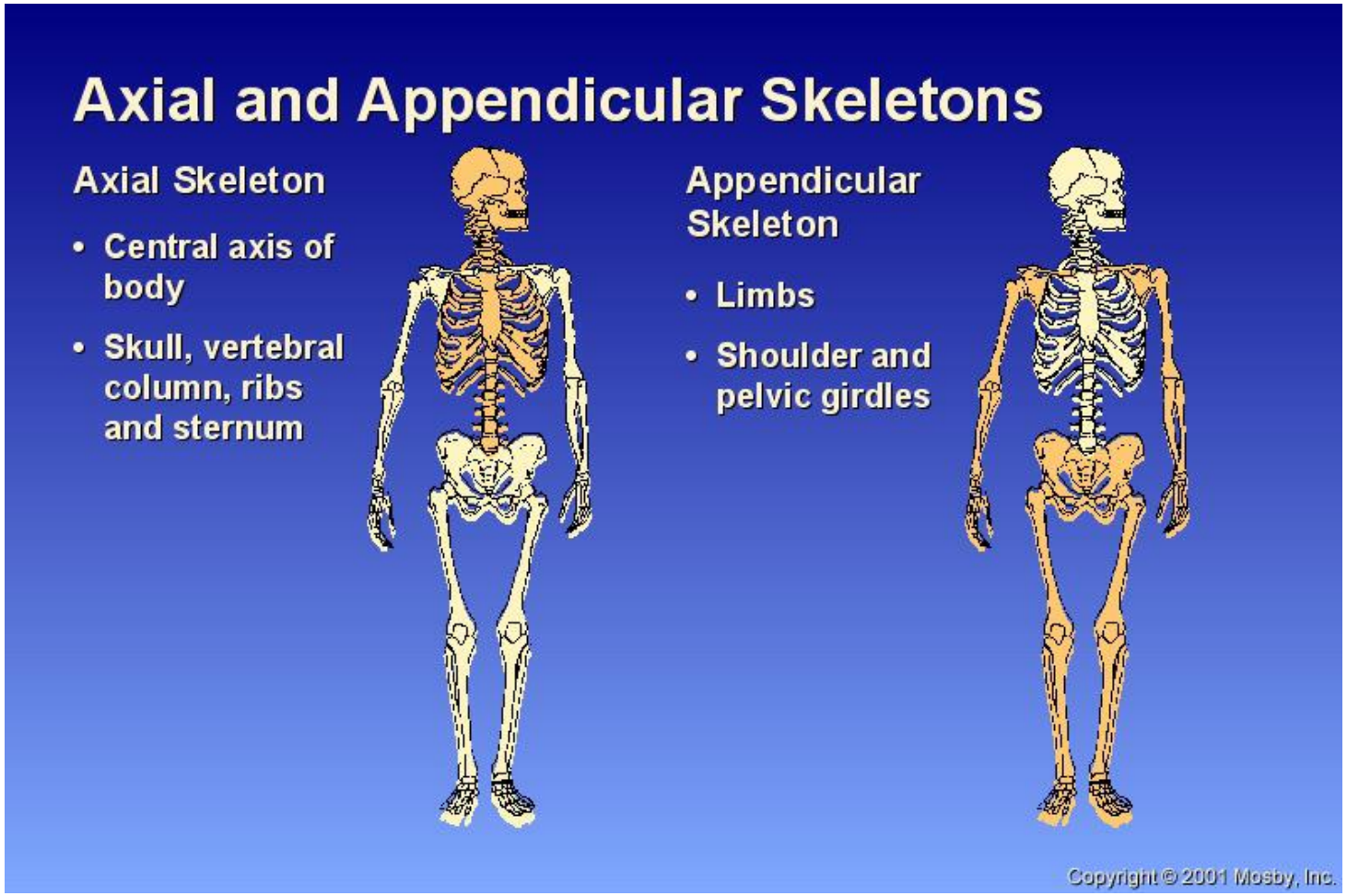
Functions of Skeleton



- Support and protect body
- Movement
- Hemopoietic factory:
  - RBCs
  - WBCs
- Storage facility for Calcium

The Skeleton

- Approximately 206 bones
- Bones united by ligaments
- Has two major divisions
  - Axial Skeleton
  - Appendicular Skeleton



Divisions of the Skeleton

Bone Remodeling and Resorption

Every 10 to 12 years all your old bone tissue is exchanged with new bone tissue.

Bone is broken down by Cells called osteoclasts.

Then Osteoblasts builds bone back up to create osteocytes which are mature bone cells.

This cycles slowly throughout your life.

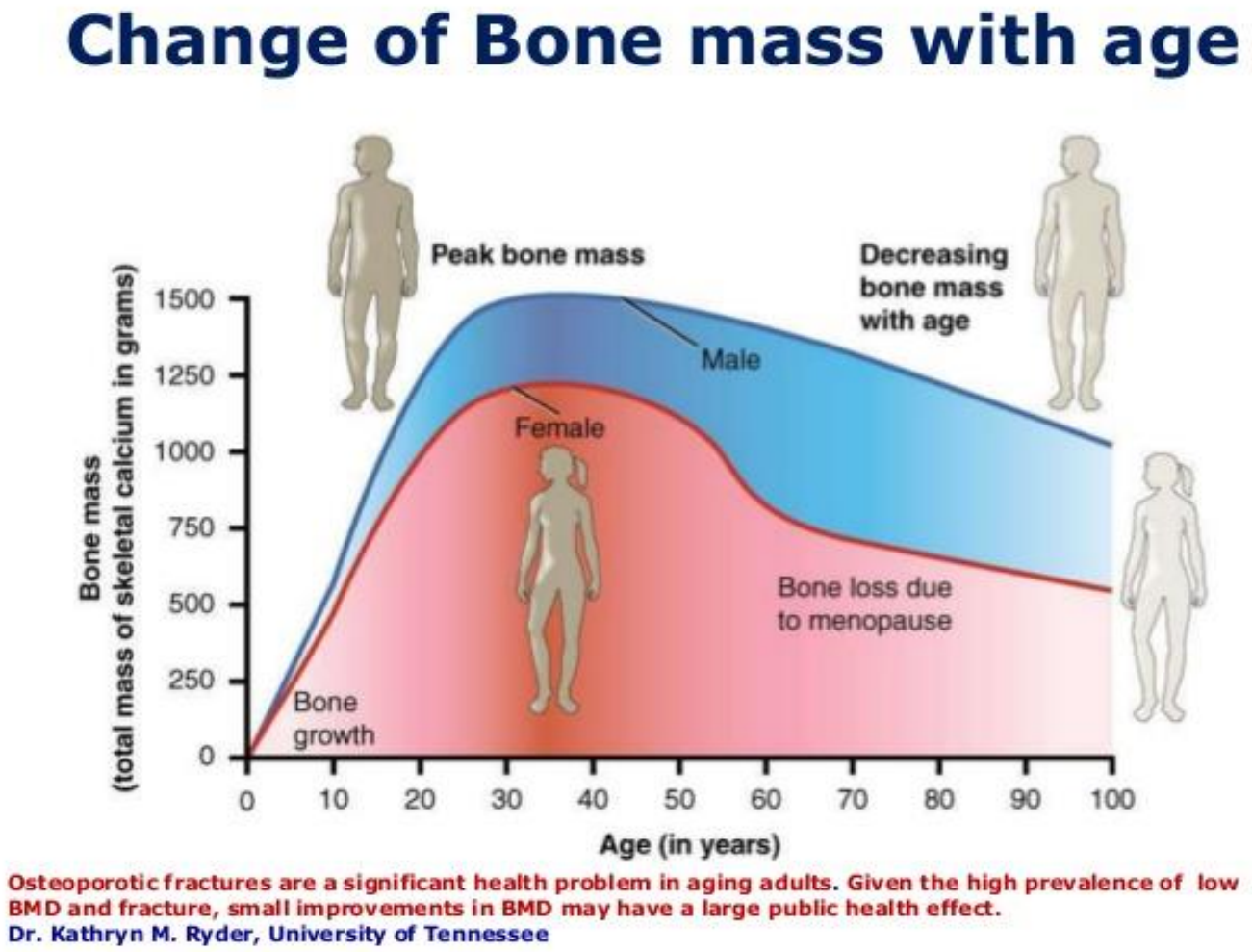
8 Common Myths about Osteoporosis

- Osteoporosis is an inevitable part of aging
- Only older women get osteoporosis
- Only Caucasian women get osteoporosis
- Osteoporosis is not very common

https://www.bonehealthandosteoporosis.org/

8 Common Myths about Osteoporosis

- Osteoporosis is not a serious or deadly condition
- Medical costs from osteoporosis are not high
- If I had osteoporosis, I would know it
- Once I have osteoporosis, there is nothing I can do about it



Where Does Osteoporosis and Bone Loss Come into Play?

Bone Loss

- Bone loss occurs when Osteoclast activity occurs more frequent than osteoblast activity.
- Meaning bone formation can’t keep up with bone resorption.
- Because bone loss occurs you can be diagnosed with Osteoporosis or Osteopenia (Low Bone Density).

Osteoporosis Definition

The Bone Health and Osteoporosis Foundation (BHOF) define osteoporosis as:

1. A bone disease that occurs when the body loses too much bone, makes too little bone, or both. As a result, bones become weak and may break from a fall or, in serious cases, from sneezing or minor bumps.
2. “porous bone”.
3. Bones that have lost density or mass and contain abnormal tissue structure.
4. As bones become less dense, they weaken and are more likely to break.

Osteoporosis

- Osteoporosis is a condition that causes bones to become thin and porous, decreasing bone strength and leading to increased risk of breaking a bone
- No single cause for osteoporosis has been identified
- Osteoporosis is often called the 'silent thief' because bone loss occurs without symptoms
- Osteoporosis can result in disfigurement, lowered self-esteem, reduction or loss of mobility, and decreased independence
- Building strong bones during childhood and adolescence can be the best defense against developing osteoporosis later.
- 90% of peak bone mass is achieved by age 20, with the remaining 10% accrued by age 30.
- Women and men begin to lose bone in their mid-30s. As women approach menopause, they lose bone at a greater rate, from 2-5% per year.

54 Million Americans,

half of all adults age 50 and older, **are at risk of breaking a bone** and should be concerned about bone health.

One in two women and up to **one in four men** will break a bone in their lifetime due to osteoporosis.

For women, the incidence is greater than that of heart attack, stroke and breast cancer combined.

OSTEOPOROTIC FRACTURES EXACT A HUGE HUMAN AND ECONOMIC TOLL

Approximately **1.8 MILLION** Medicare beneficiaries suffered approximately **2.1 MILLION OSTEOPOROTIC FRACTURES IN 2016**

The total estimated allowed medical cost to Medicare FFS in the six-month period following subsequent fractures that were suffered up to three years following an initial fracture in 2016 was **$5.7 BILLION**

Actual total costs may be even higher

Preventing 20% of subsequent fractures in Medicare FFS could have saved **$1.1 BILLION** in 2016

Financial Costs of Osteoporosis

In the United States, osteoporosis affects over 10 million adults, has high societal costs ($22 billion in 2008), and is currently being underdiagnosed and undertreated. With the anticipated population aging and increasing in number, annual fractures are projected to increase by 68% from 1.9 million (in 2018) to 3.2 million (in 2040), with related costs rising from $57 billion to over $95 billion.

- Approximately 300,000 hip fractures occur annually in the United States. With the aging population increasing, the number of hip fractures is expected to double by the year 2050.
- The total annual direct medical costs associated with all hip fractures was $50,508 per patient, resulting in a yearly estimate of $5.96 billion to the U.S. health-care system.
- In 2005, spending on America's senior population accounted for approximately 35% of federal noninterest spending. That percentage rose to 40% in 2018 and is projected to rise to 50% in 2029.
- The incremental annual medical costs in the year following a new osteoporotic fracture increased 263% for skilled nursing facility (SNF) services compared to the year prior to the fracture, accounting for nearly 30% of the total incremental annual medical cost.
- Reducing secondary fractures by just 20% could save $1.2 billion dollars.

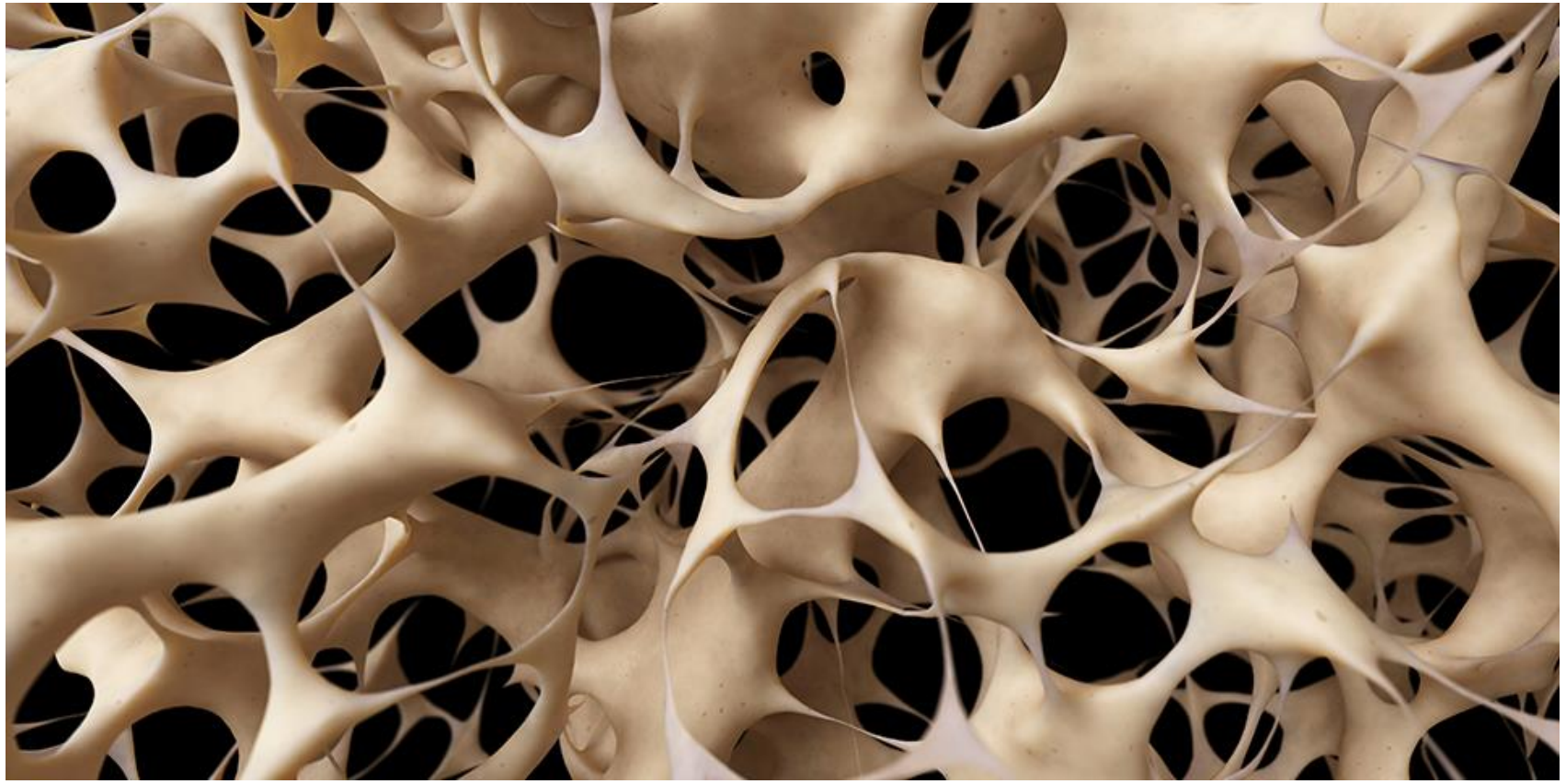
Human Costs

Physical effects can include chronic pain, reduced mobility, loss of height, disability and premature death. Furthermore, psychological consequences often ensue.

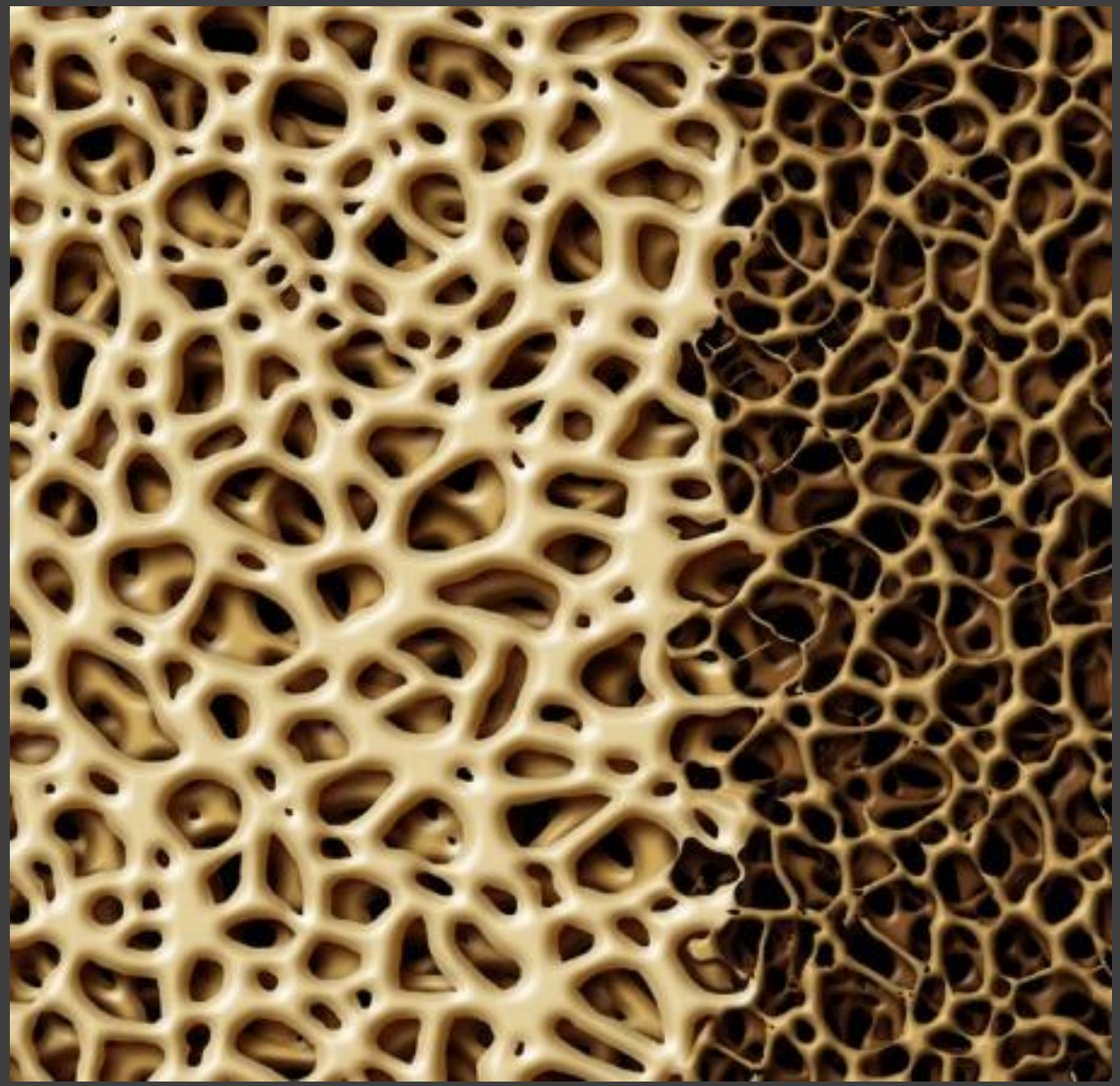
One of the most commonly reported is anxiety due to fear of future fractures, consequent impairment and worries about falling. Depression, another common emotional reaction among individuals living with a chronic illness, is also associated with osteoporosis.

- About 30% of those with a hip fracture die of any cause within the following year
- Men were 1.3x more likely to die of any cause within a year of a hip fracture compared to women (PHAC, 2020)
- WOMEN were 2x more likely to fracture their hip compared to men (PHAC, 2020)
- 25% of Americans who experience a hip fracture move from the hospital to a nursing home, and 25% die in the year following the fracture.

Osteoporotic Bone



https://www.nof.org/patients/what-is-osteoporosis/



Non-Osteoporotic bone

Inherent Risk Factors of bone loss.

Your Gender

- **Women have less bone tissue and lose bone more rapidly than men because of the changes involved in menopause**

Age –

- **the older you are, the greater your risk of osteoporosis**
- **Bones lose mass or hardness as you age for varying reasons**

Inherent Risk Factors

Family history –

- Fracture risk may be hereditary
- Osteoporosis is hereditary as well

Body size –

- Small, thin-boned women are at greater risk

Ethnicity –

- The fairer the skin, the less inherent skeletal mass

Risk Factors You Can Control

- Lack of weight bearing exercise.
- Immobility!! If you don't use it, you lose it
- Diet deficient in Calcium and vitamin D.

- Deficiencies in Sex hormones:
  - Low estrogen level (menopause)
  - Low testosterone level in males

QUIT SMOKING and Vaping!!!

Cigarette smoking

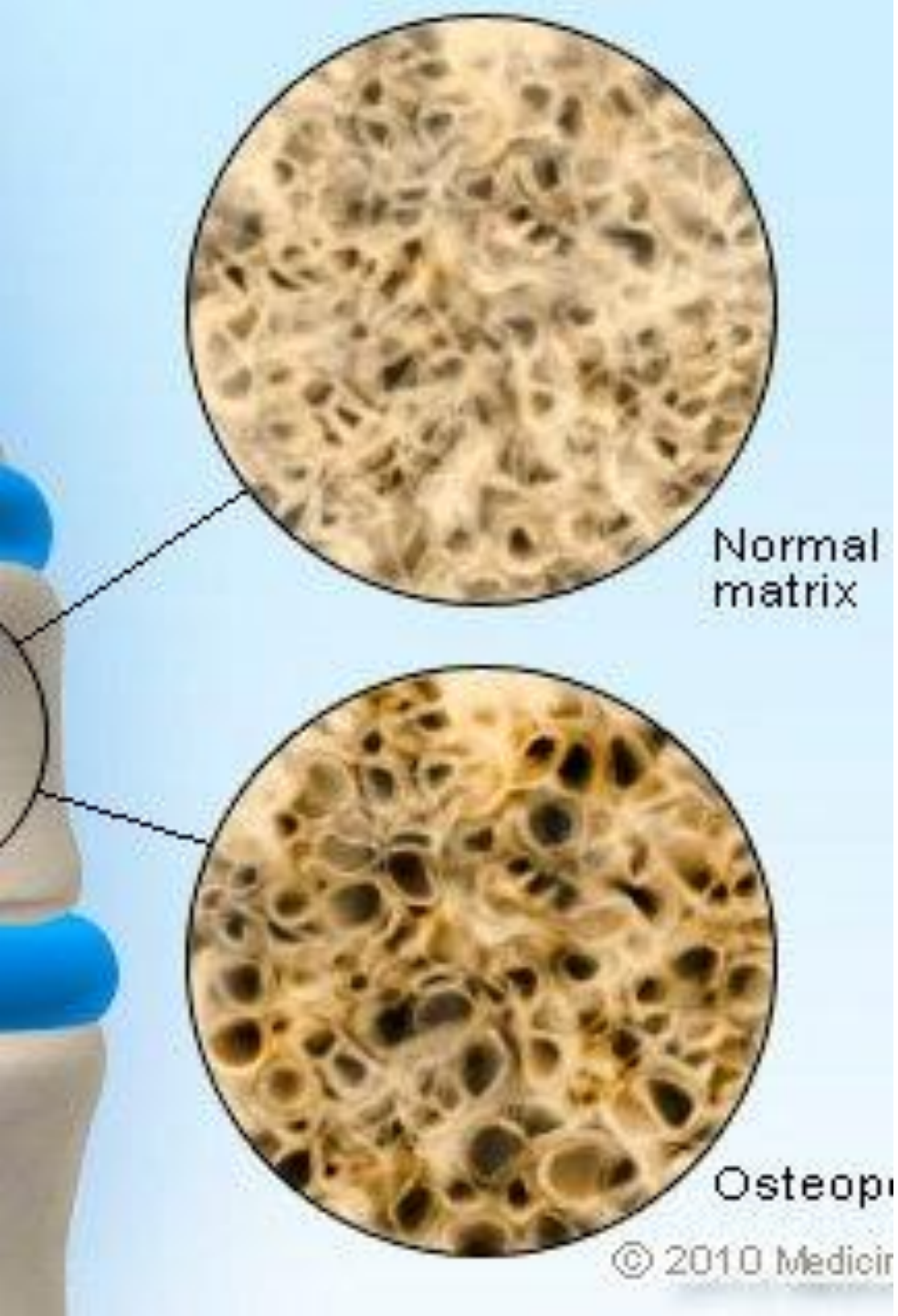
- Negates the effects of estrogen
  - Natural or supplemental
- Smokers tend to go through menopause 2 years earlier than nonsmokers
- Smokers tend to be sedentary
- More rapid loss of trabecular bone mass

Excessive use of alcohol

- Moderate intake is considered 2 drinks per day
- Liver damage
- Alcohol is toxic to osteoblasts
- An inebriated person is more likely to fall

Classifications of Osteoporosis

- **Primary**
- **Secondary**
- **Juvenile**



Primary Osteoporosis

Two Types

- Type I - Bone loss following menopause
- Type II - Related to the aging process

Type I

Postmenopausal women are the most susceptible to primary osteoporosis with an estimated 32% of these women developing the disease.

Occurs in females

Decrease in estrogen levels

High turnover

Postmenopausal females ages 50-65

Significant reduction in trabecular or cancellous bone

Vertebral and wrist fractures

Type II

- “Low turnover or “senile” osteoporosis
- Age >65
- Males begin to become affected at this stage
- Age-related decline in the function of the osteoblastic cells
- Loss of cortical bone as well as trabecular
- Hip fractures begin

Secondary Osteoporosis

Caused by a “secondary type of factor”

- Disease process
- Surgery which affects the endocrine system
- Medication

Hyperparathyroidism

The parathyroid glands secrete parathyroid hormone (PTH)

PTH regulates release of the calcium from bone, absorption of calcium in the intestine, and excretion of calcium in the urine.

Parathyroid glands secrete excessive PTH

Serum calcium rises-Hypercalcemia

85 percent of hyperparathyroidism is caused by an adenoma on one of the parathyroid glands, causing it to become overactive

Rarely hyperparathyroidism is caused by cancer of a parathyroid gland.

Malabsorption syndromes

- Irritable Bowel Disease
- Crohn's Disease
- Sprue

IBD and Crohn's

Crohn's Disease

- can occur anywhere along the digestive tract from the mouth to the anus.

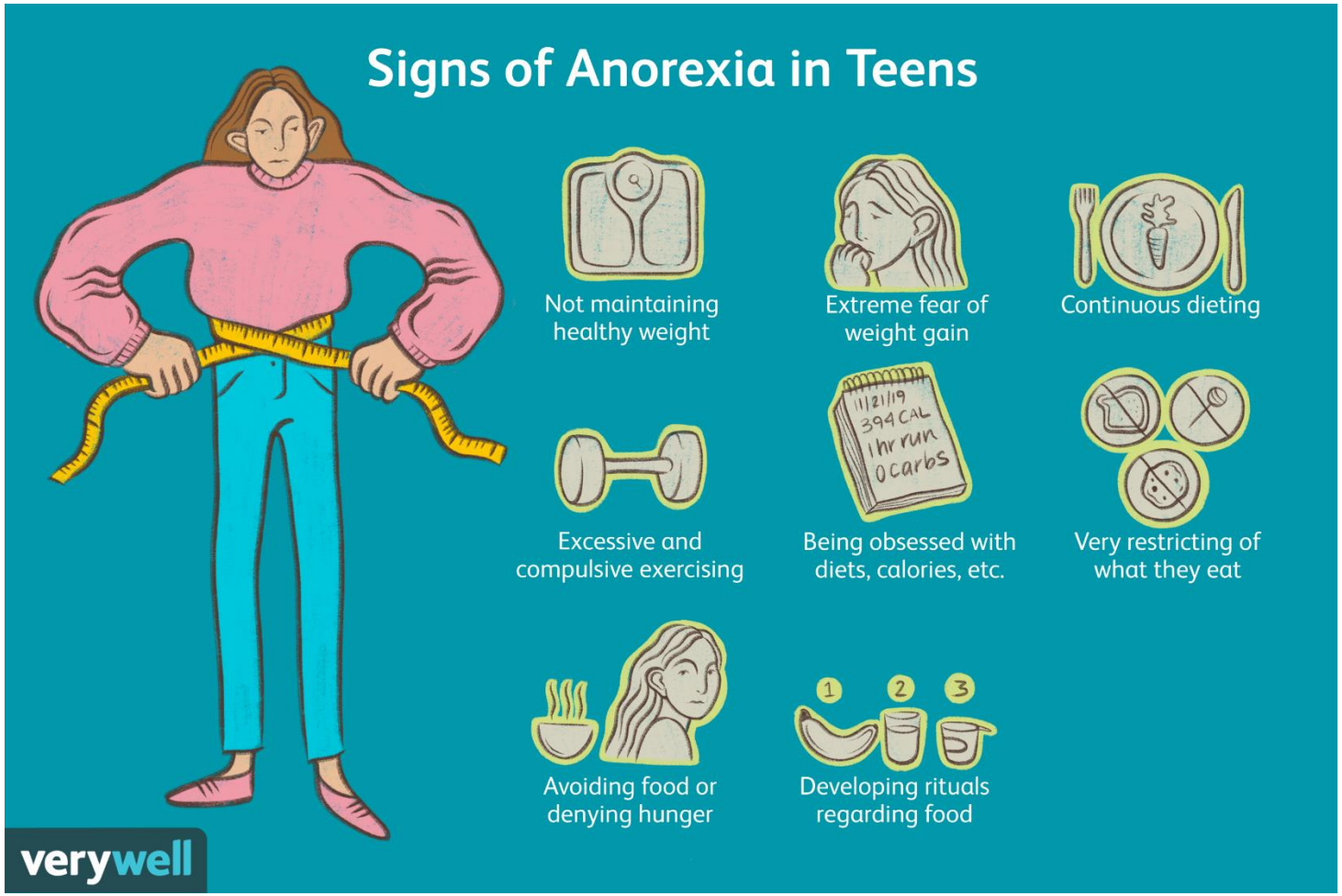
Ulcerative Colitis

- Typically, the large intestine is the only site affected.

- In some people the terminal ileum may also show inflammation.

Sprue

- Also known as Celiac Disease
- Genetic, inheritable immunologic disease which interferes with the digestion process of gluten products
- When a celiac person eats foods that contain gluten, the immune system responds by damaging the villi in the small intestine.
- Gluten can be found in wheat, rye, barley, and possibly oats.

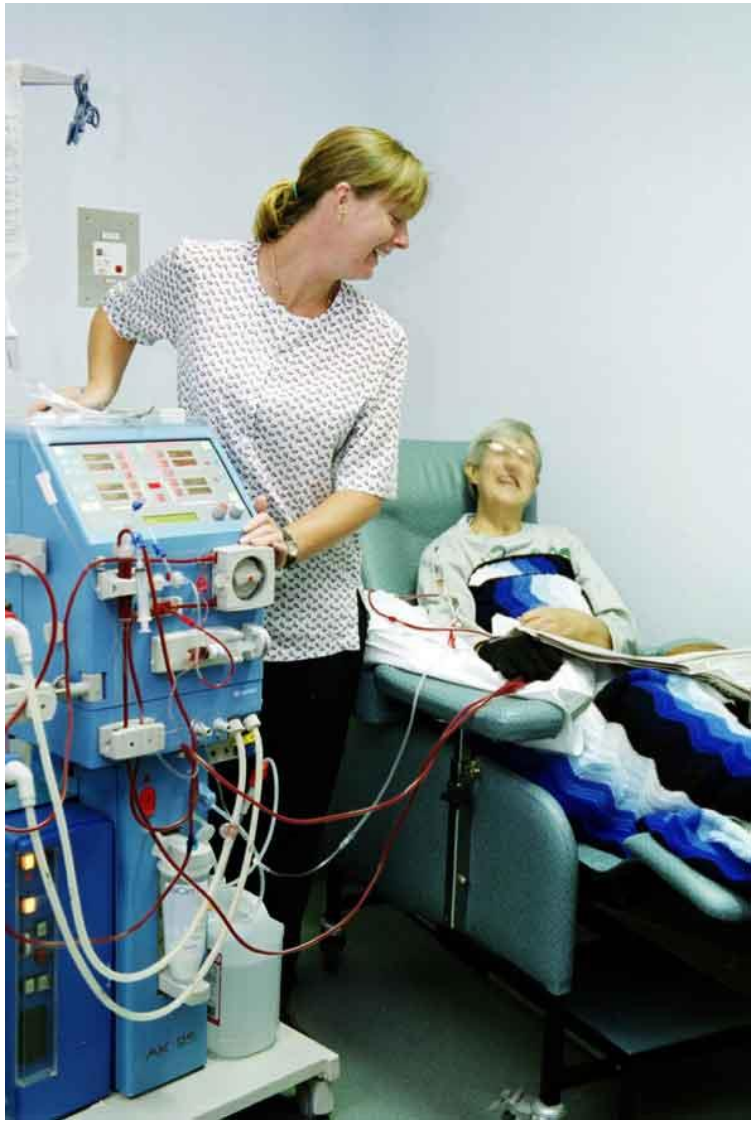


Anorexia Nervosa/Bulimia

- May present in male or females
- Decreased body fat levels
- Did patient reach their peak BMD?

Other Issues

- Patients with anorexia often produce excessive amounts of Cortisol
- There can also be a decrease in the production of growth hormone and other growth factors
- Calcium deficiency



Renal disease

- Kidneys are gatekeepers for calcium levels
- Patients may be on dialysis
- Patients may be transplant patients as well
- Patients will show a decrease in both trabecular and cortical bone mass

Gastrectomy/Intestinal bypass surgery

- Decreased caloric intake
- Decreased absorption of nutrients
- Can lead to bone loss

Spinal Cord Injury Patients

Loss of the ability to create load bearing situations causes bone loss.

Patients in wheelchairs tend to lose much more bone density in the legs then in the spine.

Fractures occur frequently in the proximal tibia.

Patients can lose as much as 24% bone loss within a year of becoming subject to a wheelchair.

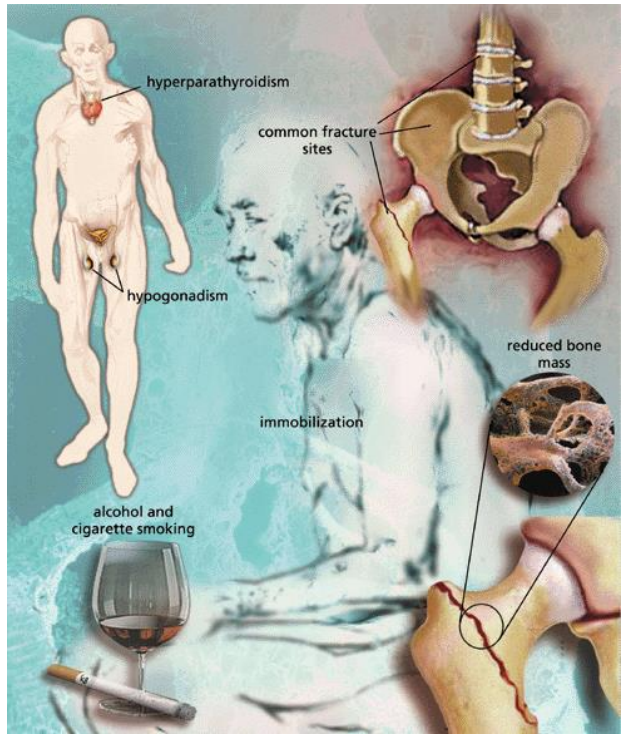
Other Disorders

- Diabetes Mellitus
- Addison’s Disease
- Cushing’s Syndrome
- Diseases of Adrenal Glands
- Acromegaly
- Liver Disease/Cirrhosis

Osteoporosis and Males

Reason's males lose bone mass

- Decrease in testosterone levels
- Inactivity
- Poor diet
- Decreased absorption of dietary calcium
- Disease processes
- Medications
- Lifestyle issues



Men Compared to Women

- Males have a higher peak bone mass
- Bone loss occurs later in life
- Don’t go through menopause
- Treatment options can vary

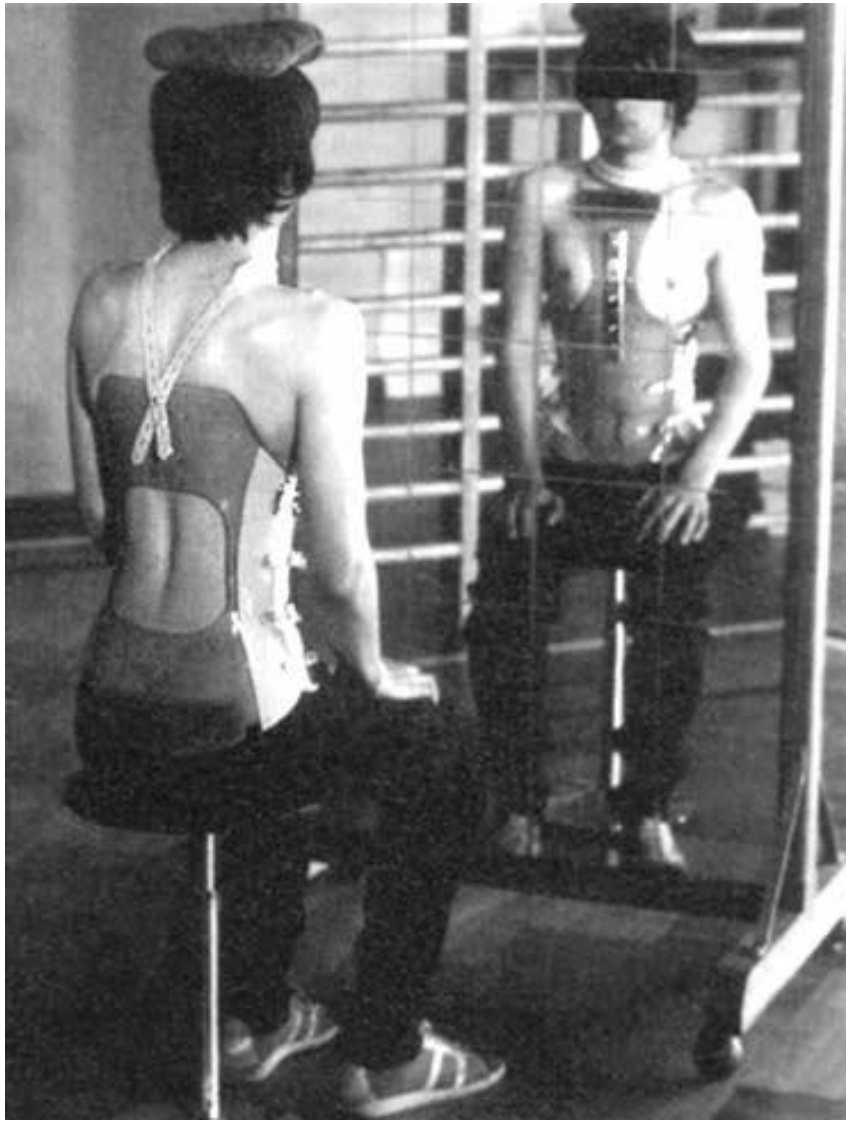
Osteoporosis is rare among children and adolescents (More appropriate term would be Lower bone density than normal for age)

Causes

- Typically, a secondary form of osteoporosis
  - Underlying medical disorder
  - Medications used to treat a medical disorder

Could be I*diopathic Juvenile Osteoporosis* (IJO).

Juvenile Osteoporosis



Symptoms of juvenile osteoporosis?

- There may not be any symptoms
- Lower back, hip, and foot pain
- Physical deformities
  - Abnormal curvature of the thoracic spine (kyphosis)
  - Loss of height
  - Sunken chest
  - Limp

Diagnosis of Juvenile Osteoporosis

- May not occur until the child has a broken bone
- Medical history is important
- Physical examination
- Diagnostic procedures may include:
  - Skeletal x-rays
  - Bone density testing
  - Blood tests (to measure serum calcium and potassium levels)

Teens and Bone Health

9 OUT 10 TEENAGE GIRLS AND 7 OUT OF 10 TEENAGE BOYS DO NOT GET ENOUGH DIETARY CALCIUM

Teens and Bone Health

- Consumption of soft drinks
- Low body weight secondary to poor body image
- Lack of weight bearing exercise
- Smoking
- Drinking
- Birth control

Female X-country runners

The Female Athlete Triad Study

Taraneh Gharib Nazem, BA[*] and Kathryn E. Ackerman, MD, MPH[†‡]

The female athlete triad (the triad) is an interrelationship of menstrual dysfunction, low energy availability (with or without an eating disorder), and decreased bone mineral density; it is relatively common among young women participating in sports. Diagnosis and treatment of this potentially serious condition is complicated and often requires an interdisciplinary team.

The Female Athlete Triad Study

This study reveled that professional female distant runners suffered from lower bone density at much higher levels than any other female athlete.

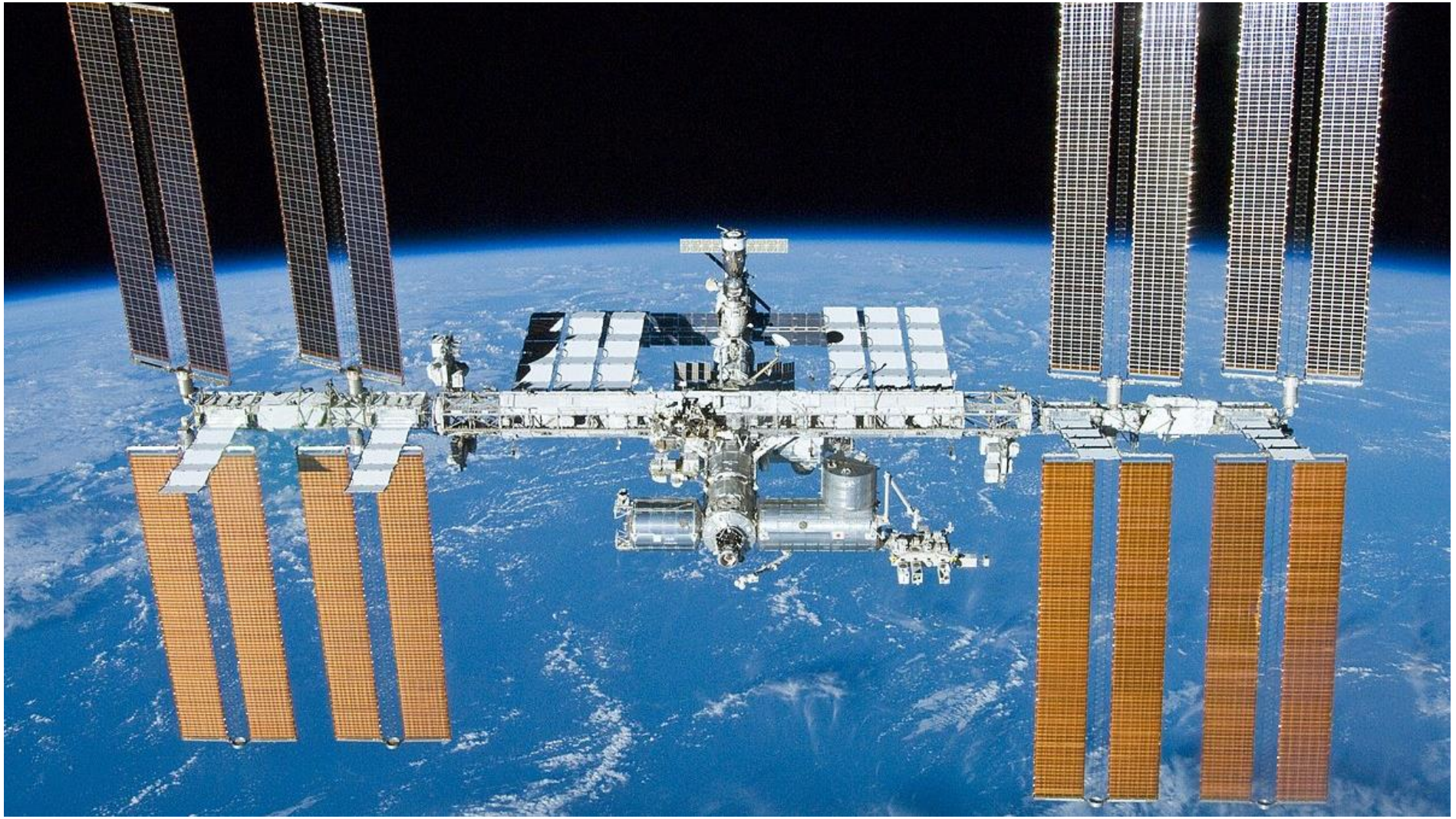
Reasons:

- Very under weight
- Bad nutrition
- Inconsistent menstrual cycles

Zero Gravity

If the earth all the sudden lost most of its gravity and we all started floating around, we would all be in a world hurt.

Our bones need loading “If you don’t use it, you lose it”



Medications That can Create bone loss

- Corticosteroids
  - Used for a multitude of diseases
  - Users of oral glucocorticoids have a 2.6-fold increase risk of fracture
- Immunosuppressive agents
- Excessive thyroid medication

Medications

- Seizure medications
  - Lithium, Dilantin
- Anticoagulants
  - Coumadin, Warfarin, Heparin

New Depo Information

Nov. 18, 2004

FDA added a "black box" warning to Depo-Provera stating that prolonged use of the injectable contraceptive may result in the loss of bone density.

The black box warning is the strongest warning the FDA issues on drugs.

Depo Provera

The warning states prolonged use of the drug may result in significant loss of bone density and that the loss is greater the longer the drug is used

It is also stated that loss of bone density associated with use of Depo-Provera may not be completely reversible after discontinuation of the drug

Warning states that a woman should only use Depo-Provera as a long-term birth control method if other birth control methods are inadequate for her

Depo Provera

Why does Depo affect BMD?

This medication reduces serum estrogen levels and is associated with a significant reduction in BMD as bone metabolism adjusts to the lower estrogen levels

Depo Provera Latest Info

Depo is not recommended for long term use and especially not for young women building their peak bone mass

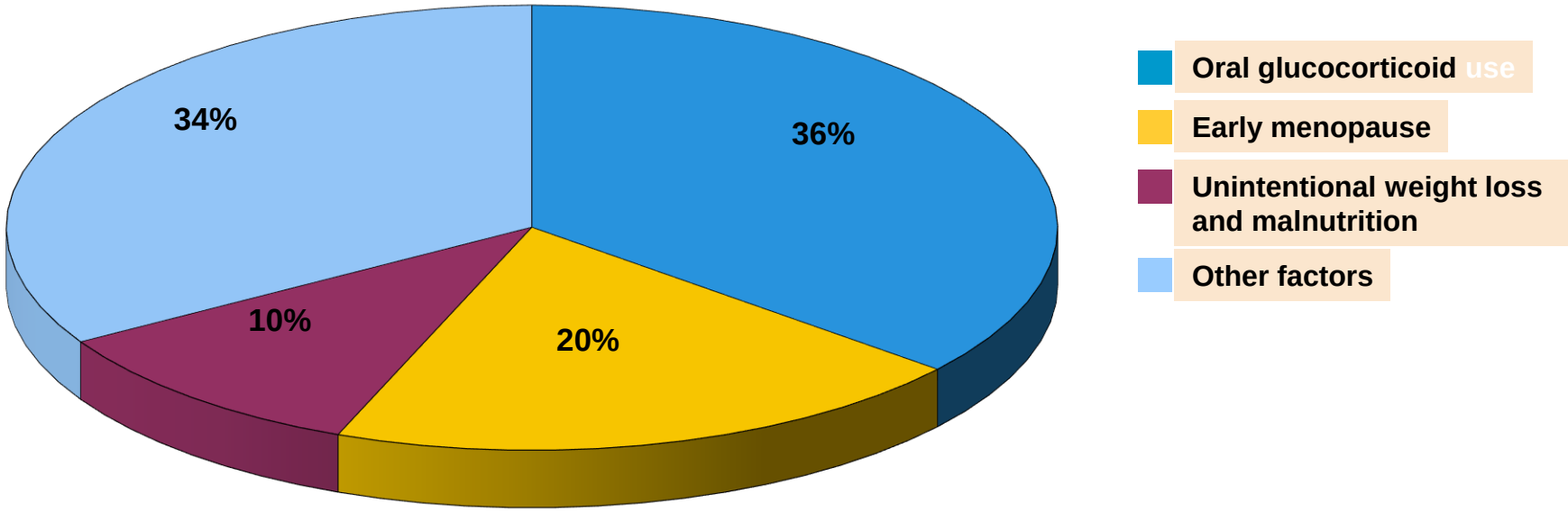
Women on Depo are advised to exercise and take in plenty of calcium

Depo Provera Latest Info

It is recommended patients have a BMD test if they have been on Depo for more than 2 years

After the last Depo injection, it can take over 6 months for the medication to clear the body

Patient history often reveals risk factors



1. Tannenbaum C et al. *J Clin Endocrin Metab*. 2002;**87**:4431–4437.

FRACTURES IN OSTEOPOROSIS

Fractures are one of the most serious clinical signs of osteoporosis as well as the clinical sequelae which have the most impact on a patient's function, psychological well-being and quality of life. As mentioned earlier 80% of hip fractures are osteoporosis-related. Hip fractures result in death in up to 20% of cases, and disability in 50% of those who survive.

An osteoporotic fracture is often referred to as a "fragility" fracture or "low-trauma" fracture. In general, both of these are referring to a fracture resulting from a fall from standing height or an equivalent degree of force. This can include: slipping on ice, tripping and falling, lifting something, coughing or sneezing. Often the term fragility fracture is interpreted to infer that the bones are particularly thin already, but a fracture resulting from a standing height fall can still cause a fracture in those who are just starting to lose bone density (osteopenic), so there seems to be a movement towards using the terminology 'low-trauma' fracture instead.

Usual sites of osteoporotic fractures include: hip, spine, wrist, ribs, and humerus. The reported lifetime fragility fracture risk is 1:2 for women; 1:4 for men.

Focus on hip & vertebral fractures

It has been reported that over 90% of hip fractures in the elderly are as a result of a fall but interestingly only 5% of all falls actually result in a hip fracture (Grisso, 1996). This suggests that it is not just the fall which causes a hip fracture; there must be a fall characteristic, like point of contact or leg orientation which is the more important determinant of a fracture (Silva, 2007).

Researchers have demonstrated that those people who fall to the side (onto the greater trochanter, for example) are 6-20 times more likely to sustain a fracture compared to other fallers (Greenspan, 1994; Hayes, 1993). Other research using computer modeling has concluded that falling on the hip laterally with the leg internally rotated results in a high possibility of fracture as the femoral neck is weakest to a postero-lateral blow (Keyak, 2001).

While hip fractures are clearly most common as a result of falls, vertebral fractures are not as likely to arise from a fall, in fact only 1/3 result from falling (Cooper, 1992). Vertebral fractures can arise from accidents or lifting heavy objects but nearly 60% are spontaneous and not related to a single incident or event. Thus, vertebral fractures may occur incrementally and not catastrophically.

Osteoporotic vertebral fractures are nearly always end-plate fractures and thus result in a crush of the vertebral body (centrally or uniformly) or an anterior wedging of the vertebral body. The most clinically obvious result of vertebral fractures is a notable thoracic kyphosis or loss of height. Interestingly, hip and vertebral fractures are related. Prevalent vertebral fractures significantly increase the risk of future hip fracture. Several studies have demonstrated a 2-3 fold increase over a 10 year period in the relative risk of hip fracture for those osteoporosis patients with a prevalent vertebral fracture versus those with no previous vertebral fracture (Black, 1999; Gunnes, 1998; Lauritzen, 1993; Melton, 1999).

Most Common Osteoporotic Fractures

- Colles' Fracture
- Thoracic and Lumbar Vertebrae
- Proximal femur

Fracture Patterns

Fracture Pattern: Bending Force

We know that if a bending force is applied to a long bone, the failure point is more than likely to be the convex (tension) side. This results in tension failure to occur progressively across the bone creating a transverse fracture. There is a purpose for the bone to fracture - it is the method in which the energy applied during the trauma is dissipated. Therefore, it is logical that if a high velocity force is applied to the bone, more energy needs to be dissipated and more cracks in the bone would be generated in the bone to dissipate this energy. Low velocity impacts usually result in a single transverse crack extending 1/3-1/2 of the circumference of the bone, often making unpredictable, oblique angles.

Fracture Pattern: Torsion

Of course, injuries to the bones don't always occur by bending but by twisting forces, such as can happen when a foot is fixed and the body falls or rotates forcefully, for example a fall while skiing. The resulting torsional load on the tibia in this case produces a constant moment throughout the long bone since the moment applied to the fixed segment (in the ski boot) is the exact magnitude but in the opposite direction as the moment closer to the knee joint.

Generally, the pattern of the torsional fracture is spiral, which is proportional to the maximum tensile strength applied. Similar to the bending fracture pattern, loads that are rapidly applied produce more fracture lines - a double spiral pattern.

Fracture Pattern: Compression

Compressive loading involves the application of equal and opposite loads into the structure, resulting in compressive stress and strain within the structure and a resulting shortening and widening of that structure. If the load is applied on the plane perpendicular to the object surface, this results in maximal compressive stress. As the vertebrae are subjected to high compressive loads under normal circumstances, it is expected that these bones in particular would be susceptible to undergoing compressive fractures. In other joints, compression fractures can be elicited with abnormally high muscular contraction forces around the joint. Although this doesn't typically apply to a vertebral segment, consider the effect of repeated, high muscular work on one aspect of the vertebrae and that contribution to developing vertebral fractures.

Typical patterns of vertebral fractures include crush and wedge fractures. Crush fractures occur in the condition in which compressive forces are distributed nearly equally throughout the entire vertebral body, thus causing an equal loss of height throughout the entire vertebral body.

Wedge fractures, on the other hand, are generally a result of accentuated compressive forces on one aspect (most typically anterior) of the vertebral body, resulting in a more wedge-shaped vertebra.

Colle's Fractures

Most common injury to the wrist are the fractures of the distal radius and ulna

A Colle's fracture involves the distal radius and ulna with posterior displacement of the distal portions and the carpal bones

Secondary to a fall

Pathology of vertebral fractures

Vertebral fractures more commonly occur spontaneously or as the result of minimal trauma resulting from spinal loading during day-to-day activities, such as bending forward, lifting objects, and climbing stairs[1,2,3]

Information courtesy of Kyphon, Inc.

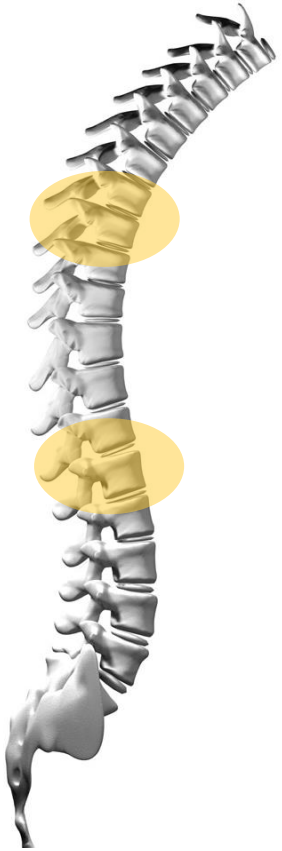
Location of vertebral fractures

The most common locations are the midthoracic region (T7–T8) and the thoracolumbar junction (T12–L1)[1]

Correspond to the most mechanically compromised regions of the spine

Midthoracic region–thoracic kyphosis is most pronounced and loading during flexion is heightened

Thoracolumbar junction–the relatively rigid thoracic spine connects to the more freely mobile lumbar segments[2]



Vertebral fractures: Three forms

- Wedge fractures are most common

Wedge | Biconcave | Crush

Detection of vertebral fracture

Often asymptomatic

Pain ranges from mild to severe and chronic, but may disappear over several weeks

Because of the complex etiology of back pain, osteoporotic fractures may not be suspected or considered, even in the presence of severe back pain not attributable to any other cause

Vertebral fractures are often not diagnosed

The height loss associated with vertebral fracture is gradual

Radiographic assessments can be inconsistent since there is often no clear definition or separation between fracture and non-fracture

Decreased BMD is associated with increased risk of vertebral fracture

A Pile of Questions

How much height are you allowed to lose as normal aging?

Where does this height loss come from?

When is height loss considered significant for your patients?

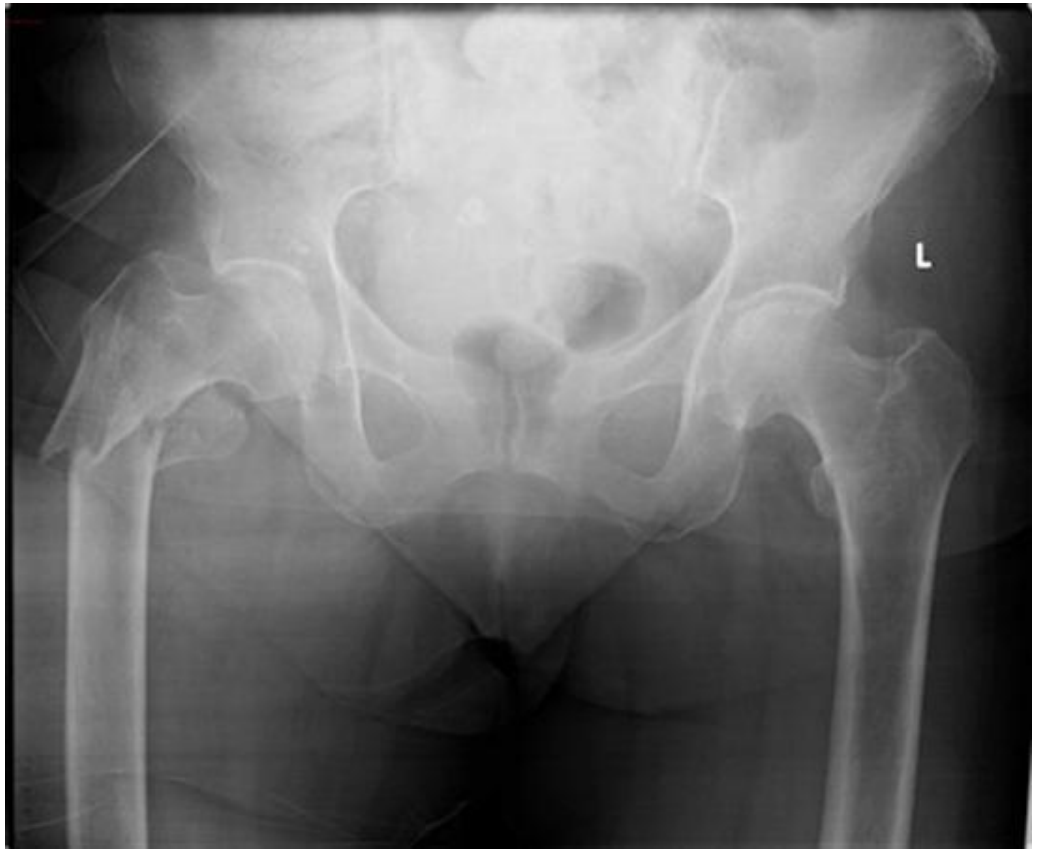
Hip Fractures

Most common injury by far in the pelvic girdle.

The neck of femur is the most common type of hip fracture associated with low bone density.

Typically caused by bearing weight and low trauma falls.

Subtrochanteric Fracture



Osteoporotic Hip Fractures with Hip Replacements

Very Difficult to Repair and Heal Correctly

Humeral Head Fractures

Not an area considered as a common area for osteoporotic fractures. However, I believe it should be.

Who is at Risk for Fracture

You can use FRAX, or the Fracture Risk Scale to determine fracture risk (see details below).

You may not have access to the bone mineral density scores.

At minimum ask: Have you had a fracture/broken bone after the age of 40?

Remember:

- Vertebral or hip fracture – high risk
- Wrist + vertebral or hip fracture – high risk
- Wrist fracture only – moderate risk

High risk means there is 20% chance they will have another fracture within the next 10 years and may affect the exercises you choose and the activities you recommend modifying.

Tools to assess fracture risk

FRAX:

In 2008, the World Health Organization (WHO) launched the FRAX tool (Fracture Risk Assessment) - www.shef.ac.uk/FRAX. In addition to femoral neck (hip) BMD, age, gender, fracture history and steroid use, FRAX also takes into account other clinical risk factors to calculate the absolute 10-year risk of a hip fracture or other major osteoporotic fracture (spine, forearm, upper arm). These factors include:

- BMI (weight to height ratio calculation)
- Parental hip fracture
- Rheumatoid arthritis
- Other secondary conditions that contribute to bone loss
- Current smoking
- Alcohol intake (three or more drinks per day)

To learn more, visit https://www.sheffield.ac.uk/FRAX/index.aspx?lang=En

Fracture Risk Scale:

A validated tool for assessing fracture risk in long-term care residents. The FRS is the first tool developed and validated to predict hip fracture over a 1-year time period using risk factors specific to long-term care residents such as prior fractures, wandering, dementia and falls. The FRS can support clinical decisions in care-planning by identifying who is at risk.

What are the benefits of FRS?

- Prevent fractures by identifying those are at the greatest risk for fractures so that preventive measures can be used
- Improve quality of life for residents as fractures can have life-changing and debilitating consequences
- Improve care to reduce pain, disability, and transfers to hospital

That’s It For This Lecture!!

Lets Take a break