**MODULE 1: Overview of Osteoporosis**

**1.1 Osteoporosis Basics**

**General Facts**

* Osteoporosis is a condition that causes bones to become thin and porous, decreasing bone strength and leading to increased risk of breaking a bone.
* The most common sites for osteoporotic fracture are the wrist, spine, shoulder and hip.
* No single cause for osteoporosis has been identified.
* Osteoporosis is often called the “silent disease” because bone loss occurs without symptoms unless one has fractured.
* Osteoporosis can strike at any age.
* Osteoporosis affects both men and women.
* More women than men have osteoporosis and low bone mass.
* The best defense again osteoporosis is to build strong bones during childhood and adolescence as it protects developing osteoporosis at a later age.
* Peak bone mass is achieved at an early age, age 16-20 in girls and age 20-25 in young men.
* Women and men alike begin to lose bone in their mid-30s; as they approach menopause, women lose bone at a greater rate, from 2-3 percent per year.1

**Prevalence**

* One in two women and one in four men over 50 will break a bone due to osteoporosis.
* About 54 million Americans are affected by osteoporosis and low bone mass – 10 million adults by osteoporosis and another 43.4 million by low bone mass.
* 8.2 million women and 2 million men have osteoporosis; 27.3 million women and 16.1 million men have low bone mass.2
* Osteoporosis is responsible for around 2 million broken bones annually, with 300,000 of those being hip fractures.3
* A women’s risk of breaking a hip due to osteoporosis is equal to her risk of breast, ovarian and uterine cancer combined. Men aged 50 or older are more likely to break a bone due to osteoporosis than to get prostate cancer.4

By 2030, the number of adults over age 50 with osteoporosis or low bone mass will grow from approximately 54 million to 68 million.2 By 2030, experts predict that osteoporosis will be responsible for over 3.2 million fractures annually.5

While most individuals with osteoporosis or low bone mass are non-Hispanic white women, a substantial number of men and women from other racial or ethnic groups also have osteoporosis and low bone mass.

The National Osteoporosis Foundation Prevalence study estimates that:

* 7.7 million non-Hispanic White
* 0.5 million non-Hispanic Black
* 0.6 million Mexican American adults have osteoporosis
* And another 33.8, 2.9 and 2.0 million, respectively, have low bone mass.2

**Costs**

*Economic*

* Over the next decade, the number of people age 65 and older is expected to continue rising, from 16 percent of the population in 2018 to 20 percent in 2029.
* 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 aging population and rising health care costs in the US are contributing to increases in spending on Social Security and Medicare. Spending on those two programs accounting for $1.3 trillion in 2018 and is expected to rise to $2.7 trillion in 2029.6
* In 2005, osteoporosis-related fractures were associated with an estimated $19 billion in Medicare costs. By 2025, annual direct costs from osteoporosis are expected to rise to approximately $25.3 billion per year.7
* Hip fractures account for the largest proportion – 63% or $11.3 billion – of costs.8

*Social*

The reduced quality of life for those with osteoporosis is significant.

Osteoporosis can result in:

* Disfigurement, lowered self-esteem, reduction or loss of mobility and decreased independence.
* High morbidity and consequent dependency associated with fractures may strain interpersonal relationships and social roles of patients and their caregivers.
* 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.
* Six months after a hip fracture, only 15% of patients can walk across the room unaided.3

**Risk factors**

Osteoporosis does not develop overnight. Bone mass can be lost steadily for many years without experiencing any symptoms or signs of the disease until a bone fractures. If osteoporosis is first diagnosed at the time a fracture occurs, it is already fairly advanced.

A fragility fracture is the most significant clinical consequence of osteoporosis, and therefore preventing a fracture, or the second fracture if one has already occurred, is of paramount importance.

**Who should have a detailed medical history taken to identify those at highest risk of fracture?**

* All women and men over age 50 to identify risk factors
* Especially anyone over 50 who has experienced a fragility fracture, which is a fracture that occurs from the equivalent force of falling from your standing height.

**What is your risk by ethnicity?**

While osteoporosis affects all races and ethnicities, people in the US who are Caucasian or of Asian or Latino descent are more likely to develop osteoporosis than those of African heritage.

**How is the Assessment Done?**

* Detailed history to identify risk factors for low BMD, future fractures and falls:
  + Prior fragility fracture
  + Parental hip fracture
  + Current smoking
  + High alcohol intake (3 or more drinks per day)
  + Inquire about falls in past 12 months
  + Inquire about gait and balance
  + Conditions or medical procedures that could cause bone loss such as rheumatoid arthritis, diabetes, and others (list available here: [www.nof.org/patients/what-is-osteoporosis/](https://www.nof.org/patients/what-is-osteoporosis/))
  + Medications that cause bone loss such as glucocorticoids, aromatase inhibitors, and others (list available here: [www.nof.org/patients/what-is-osteoporosis/](https://www.nof.org/patients/what-is-osteoporosis/))
* Physical examination
  + Measure weight
  + Screening for vertebral fractures:
    - Measure height annually
    - Spinal x-ray indicated if there is evidence of vertebral fracture
  + Assess fall risk by using Get-Up-and-Go or other validated tests (available as part of CDC’s STEADI initiative).

**1.2 Testing**

**About BMD testing**

***Who should have a BMD test?***

* All women age 65 or older
* All men age 70 or older
* Menopausal or postmenopausal women and men age 50-69 with risk factors (see risk factors section)
* If any of the following apply:
  + A spinal X-ray shows a break or bone loss in the spine
  + Back pain with a possible break in the spine
  + Height loss of ½ inch or more within one year
  + Total height loss of 1½ inches from original height

***What exactly happens during a bone mineral density test?***

The most common bone density test today is the dual energy x-ray absorptiometry (DXA).

This test involves lying on a table for several minutes while a small x-ray detector scans the spine, one hip, or both. The amount of light (x-ray) that passes through the bone is measured, thus indicating how dense (thick or thin) the bones are.

The test is safe and painless and does not require any injections or any other discomfort. A very small amount of radiation from a DXA test is transmitted.

**How test results are read**

The patient’s bone density is compared to the bone density of an average young adult.

A T-score is calculated that describes the density of the bones (usually at the spine and hip) compared to this average.

The T-score is expressed in units, “standard deviations (SDs),” indicating how far the score deviates from what is considered normal for a young adult.

Below normal is always indicated with a minus (-) sign.

**World Health Organization**

**classification of osteoporosis:**

*T-score ≤ -2.5 SD= osteoporosis*

*T-score between -1 & -2.5 SD =osteopenia*

*(low bone density)*

*T-score ≥ -1 SD = normal bone density*

It should be noted that BMD test results and the WHO classifications are only part of the picture in determining risk for fracture.

**Determining the 10-Year Absolute Fracture Risk: FRAX**

In 2008, the World Health Organization (WHO) launched the FRAX tool (Fracture Risk

Assessment) - [www.shef.ac.uk/FRAX](http://www.shef.ac.uk/FRAX)

In addition to femoral neck (hip) BMD, age, gender, fracture history and steroid use, FRAX also considers 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)

The FRAX system is based upon a more complete set of clinical risk factors and it can be used without BMD results, but it requires access to FRAX software, website, or paper chart.

**TBS iNsight© Bone Fracture Risk calculator**

Garvan Institute for Medical Research also has a Bone Fracture Risk calculator that uniquely includes falls as a risk factor.

TBS iNsight**©** is a software tool that installs on existing DXA scanners. It is a simple, rapid and reproducible method that estimates fracture risk based on a determination of bone texture (an index correlated to bone microarchitecture), in addition to risks determined by DXA bone mineral density and clinical risk factors. The result is expressed as a Trabecular Bone Score (TBS).

**VirtuOst BMD and Bone Strength Test**

The VirtuOst test goes beyond BMD by providing measurements of both BMD and bone strength. The VirtuOst test can be applied as an add-on analysis to most types of clinical CT exams that contain the hip and/or spine, regardless of the indication for the original CT scan.

VirtuOst uses the engineering-based finite element analysis technique to provide a virtual stress test of a patient's bone to measure its breaking strength. This measurement accounts for such important strength characteristics as: 1) the size and three-dimensional shape of the patient's bone; 2) the internal spatial distribution of bone mass including the relative amount of cortical and trabecular bone; 3) the biomechanical properties of bone tissue; and 4) the external loading conditions associated with fracture.

Fracture-outcome studies have consistently demonstrated that older people with very low levels of either BMD or bone strength are at high risk of fracture. This dual measurement is important because many high-risk patients with fragile bone strength do not have BMD-defined osteoporosis.

**1.3 Treatment Recommendations**

*Prescription Medications, Nutrition & Supplements, Physical Activity*

**Medications**

There are various FDA-approved medications available to treat osteoporosis and reduce the risk of fracture. They fall into two basic categories:

* Antiresorptive drugs work by slowing the resorption or breakdown part of the remodeling cycle.
* Anabolic drugs work by stimulating the formation part of the remodeling process. More bone is formed than is taken away.

**Osteoporosis Medicines Approved by the FDA**

Listed by Class

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Class/Drug** | **Brand Name** | **Form** | **Frequency** | **Gender** |
| Antiresorptive Agents | | | | |
| Bisphosphonates | | | | |
| Alendronate | Fosamax®, Fosamax Plus D™ | Oral (Tablet, Solution) | Daily/Weekly | Women & Men |
| Alendronate | Binosto® | Oral (Effervescent Tablet) | Weekly | Women & Men |
| Ibandronate | Boniva® | Oral (Tablet) | Monthly | Women |
| Ibandronate | Boniva® | Intravenous (IV)  Injection | Every 3 Months | Women |
| Risedronate | Actonel® | Oral (Tablet) | Daily/Weekly/Twice  Monthly/Monthly | Women & Men |
| Risedronate | Atelvia™ | Oral (Tablet) | Weekly | Women |
| Zoledronic Acid | Reclast® | Intravenous (IV)  Infusion | Once A Year/Once Every Two Years | Women & Men |
| RANK ligand (RANKL) inhibitor | | | | |
| Denosumab | Prolia™ | Injection | Every 6 months | Women & Men |
| Calcitonin | | | | |
| Calcitonin | Fortical®, Miacalcin® | Nasal Spray | Daily | Women |
| Calcitonin | Miacalcin® | Injection | Varies | Women |
| Estrogen\* (Hormone Therapy) | | | | |
| Estrogen | Multiple Brands | Oral (Tablet) | Daily | Women |
| Estrogen | Multiple Brands | Transdermal (Skin  Patch) | Twice Weekly/Weekly | Women |
| Estrogen Agonist/Antagonist  also called selective estrogen receptor modulators (SERMs) | | | | |
| Raloxifene | Evista® | Oral (Tablet) | Daily | Women |
| Tissue Specific Estrogen Complex (TSEC) | | | | |
| Estrogen/ Bazodoxifene | Duavee® | Oral (Tablet) | Daily | Women |
| Anabolic Agents | | | | |
| Parathyroid Hormone (PTH) Analog | | | | |
| Teriparatide | Forteo® | Injection | Daily | Women & Men |
| Parathyroid Hormone-Related Protein (PTHrp) Analog | | | | |
| Abaloparatide | Tymlos® | Injection | Daily | Women |
| Sclerostin Inhibitor | | | | |
| Romosozumab-aqqg | Evenity® | Injection | 2 injections once monthly for 12 months | Women |
| \*Estrogen is also available in other preparations including a vaginal ring, cream, by injection, and as an oral tablet taken sublingually (under the tongue).  The vaginal preparations do not provide significant bone protection. | | | | |

**Antiresorptive Medicines**

**Bisphosphonates**

Bisphosphonates are a family of drugs used to treat osteoporosis. There are four bisphosphonates currently approved for use in the U.S:

Alendronate: Generic Alendronate, Fosamax ®, Fosamax Plus DTM, Binosto®

Ibandronate: Boniva®

Risedronate: Actonel ®, Actonel® with Calcium, AlteviaTM

Zoledronic Acid: Reclast®

**How do they work?**

Bisphosphonates bind to the surfaces of the bones and slow down the bone resorbing action of the osteoclasts. This allows the osteoblasts to work more effectively.

**How effective are they?**

All four bisphosphonates increase bone density and prevent vertebral fractures. Alendronate, risedronate and zoledronic acid have also been shown to prevent hip and non-vertebral fractures.

**Who can take them?**

Bisphosphonates are used to treat osteoporosis in postmenopausal women and in men; and in men and women of any age who are using steroid medications.

**How are they taken?**

Bisphosphonates have very specific instructions about how they must be taken in order to be absorbed properly and avoid side effects. Because calcium interferes with the absorption of bisphosphonates, calcium supplements must be taken at other times of the day.

**Are there side effects?**

The most common side effects are nausea, abdominal pain and loose bowel movements. Bone, joint and/or muscle pain has been infrequently reported in patients taking bisphosphonates. There is a small risk of ulcers in the esophagus with both alendronate and risedronate, especially if taken incorrectly.

The most common side effects of zoledronic acid, which usually only last a day or two, are fever, pain in the muscles, bones or joints, and headache.

There have been rare cases of acute renal dysfunction following infusion of zoledronic acid.

In very rare cases, alendronate, risedronate and zoledronic acid have been linked to a breakdown of the jaw bone (called osteonecrosis of the jaw) following dental work such as dental extractions. Rare cases of atypical fractures of the femoral (thigh) bone have also been reported. One should notify their physician if they experience pain in the groin or thigh that is present for a few weeks.

**Rank ligand (RANKL) inhibitor**

Denosumab (Prolia®) belongs to a different class of osteoporosis treatment called Rank ligand (RANKL) inhibitor.

**How does Denosumab work?**

Denosumab is an anti-resorptive treatment that inhibits the development and activation of osteoclasts (the cells that eat away bone).

**How effective is it?**

Denosumab increases bone density and reduces the incidence of spine and non-spine fractures, including hip fractures.

**Who can take it?**

Denosumab can be used to reduce the risk of fractures in postmenopausal women and men with osteoporosis.

**How is it taken?**

Denosumab is an injection under the skin given by a trained healthcare professional, twice a year. The dose is 60 mg.

**Are there side effects?**

Denosumab may lower calcium levels in the blood and requires a blood test after each does. People who have weak immune systems may have an increased risk of serious infections. Side effects may also include pain in the muscles, arms, legs or back and a skin condition with itching, redness and/or dryness. It also slightly increases the risk of cellulitis, a skin infection that is treated with antibiotics. In rare cases, osteonecrosis of the jaw and atypical femur fractures are reported in patients treated with Demosumab.

**Calcitonin**

Calcitonin medicine is a synthetic hormone for the treatment of osteoporosis. The brand name medications approved in the US are: Fortical® and Miacalcin®.

**How does Calcitonin work?**

Calcitonin is involved in calcium regulation and bone metabolism.

**How effective is it?**

Calcitonin slows bone breakdown and increases bone density in the spine. It reduces the risk of spine fractures but has not been shown to decrease the risk of non-spine or hip fractures.

**Who can take it?**

Calcitonin is approved for postmenopausal women who are at least five years beyond menopause.

**How is it taken?**

Calcitonin is available as a nasal spray (200 IU daily) or an injection of 100 IU daily administered as a subcutaneous or intramuscular injection.

**Are there side effects?**

Common side effects with nasal calcitonin are a runny nose, headache, back pain and nosebleed (epistaxis). Injectable calcitonin may cause an allergic reaction and unpleasant side effects including flushing of the face and hands, urinary frequency, nausea and a skin rash.

**Estrogen (Hormone Therapy)**

**How does Estrogen work?**

Hormone therapy is approved for the prevention of osteoporosis.

**How effective is it?**

Hormone therapy reduces bone loss, increases bone density in both the spine and hip, and reduces the risk of hip, spine and other fractures in postmenopausal women. Hormone therapy also relieves menopausal symptoms.

**Who can take it?**

Hormone therapy is approved for postmenopausal women.

**How is it taken?**

Hormone therapy is commonly available as a tablet or skin (transdermal) patch and in other forms and in a wide variety of doses.

**Are there side effects?**

When estrogen is taken alone, it can increase a woman’s risk of developing cancer of the uterine lining (endometrial cancer). To reduce this risk in women that have a uterus, physicians prescribe the hormone progesterone in combination with estrogen. Side effects may include vaginal bleeding in women with a uterus, breast tenderness and gallbladder disease.

According to the FDA, postmenopausal women should consider other osteoporosis medicines before hormone therapy. Women who decide to take hormone therapy should take the lowest possible dose for the shortest period of time to control menopausal symptoms and achieve desired goals.

**Estrogen Agonists/Antagonists**

Raloxifene (brand name Evista®) is the estrogen agonists/antagonists currently approved to treat osteoporosis.

**How does Raloxifene work?**

Raloxifene is approved for the prevention and treatment of osteoporosis.

**How effective is it?**

Raloxifene reduces the risk of spine fractures. There are no data showing that raloxifene reduces the risk of hip and other non-spine fractures.

**Who can take it?**

Raloxifene is approved for postmenopausal women.

**How is it taken?**

For both prevention and treatment, raloxifene is taken daily as a 60 mg tablet, with or without meals.

**Are there side effects?**

Side effects include hot flashes, leg cramps and an increased risk of deep vein thrombosis (blood clots). Other side effects include swelling and temporary flu-like symptoms. Raloxifene should not be taken by women at increased risk for stroke. This includes women who have had previous strokes, transient ischemic attacks (TIAs), atrial fibrillation (a type of serious irregular heart beat) or uncontrolled hypertension (high blood pressure).

**Tissue Specific Estrogen Complex**

Conjugated Estrogens/Bazedoxifene (brand name Duavee®) is the Tissue Specific Estrogen Complex currently approved to treat osteoporosis.

**How does conjugated estrogens/bazedoxifene work?**

The combination of conjugated estrogens and bazedoxifene is approved for women who suffer from moderate-to-severe hot flashes associated with menopause and also to prevent osteoporosis after menopause.

**How effective is it?**

In women who were between 1 and 5 years post-menopause, use of this combination medicine increased the average spine bone mineral density at 12 months when compared to those who did not take the drug. Hip bone mineral density was also increased at 12 months when compared to those who did not take the drug.

**Who can take it?**

Conjugated estrogens/bazedoxifene should be used only by post-menopausal women who have a uterus.

**How is it taken?**

Each daily tablet contains 0.45 mg of conjugated estrogens and 20 mg of bazedoxifene and can be taken without regard to meals.

**Are there side effects?**

Because it contains estrogen, the same precautions and warnings for estrogen apply to conjugated estrogens/bazedoxifene. Side effects may include muscle spasms, nausea, pain and dizziness.

**Anabolic Medicines**

**Parathyroid Hormone (PTH) Analog**

Teriparatide (brand name Forteo®) is the parathyroid hormone medication approved to treat osteoporosis.

**How does Teriparatide work?**

Teriparatide, a type of parathyroid hormone, rebuilds bone and significantly increases bone mineral density.

**How effective is it?**

Teriparatide reduces the risk of spine and non-spine fractures.

**Who can take it?**

Teriparatide is approved for treatment of osteoporosis in postmenopausal women and in men who are at high risk of breaking a bone and treatment of osteoporosis in men and women as a result of long-term use of steroid medications who are at high risk of breaking a bone.

**How is it taken?**

Teriparatide is self-administered as a daily injection under the skin from a pre-loaded pen that contains a four-week supply of medicine. It can be taken for a maximum of two years. At the end of two years, bone loss can be rapid. In order to retain the benefits of treatment with teriparatide, most experts recommend that patients start an antiresorptive medicine right after finishing the teriparatide therapy.

**Are there side effects?**

Side effects can include leg cramps, nausea and dizziness. Modest elevations in serum and urine calcium can occur, but there is no documented increase in the risk of kidney stones. People with certain conditions should not take this medicine.

**Parathyroid Hormone-Related Protein (PTHrp) Analog**

Abaloparatide (Brand Name Tymlos®) is the parathyroid hormone-related protein approved to treat osteoporosis.

**How does Abaloparatide work?**

Abaloparatide acts as an agonist at the PTH1 receptor (PTH1R). This results in activation of the cAMP signaling pathway in target cells. In rats and monkeys, abaloparatide had an anabolic effect on bone, demonstrated by increases in BMD and bone mineral content (BMC) that correlated with increases in bone strength at vertebral and/or nonvertebral site.

**How effective is it?**

Abaloparatide works as a treatment for osteoporosis in patients at high risk for fracture, specifically those with a history of fracture, multiple risk factors for a fracture, or if a patient in intolerant to other available therapies.

**Who can take it?**

Abaloparatide is approved for treatment of osteoporosis in postmenopausal women who are at high risk of breaking a bone.

**How is it taken?**

Abaloparatide is supplied as an injection for subcutaneous injection. Cumulative use of abaloparatide and parathyroid hormone analogs (e.g., teriparatide) for more than 2 years during a patient’s lifetime is not recommended. Patients should receive supplemental calcium and vitamin D if dietary intake is inadequate.

**Are there side effects?**

Adverse effects associated with the use of abaloparatide may include, but are not limited to, the following: hypercalciuria, dizziness, nausea, headache, palpitations, fatigue, upper abdominal pain, vertigo. 8

**Sclerostin Inhibitor**

Romosozumab-aqqg (Brand Name Evenity®) is the Sclerostin Inhibitor approved to treat osteoporosis.

**How does Romosozumab-aqqg work?**

Romosozumab-aqqg is a humanized monoclonal antibody (IgG2) produced in a mammalian cell line by recombinant DNA technology that binds to and inhibits sclerostin.

**How effective is it?**

Romosozumab-aqqg works as a treatment for osteoporosis in patients at high risk for fracture, specifically those with a history of fracture, multiple risk factors for a fracture, or if a patient in intolerant to other available therapies.

**Who can take it?**

Romosozumab-aqqg is approved for treatment of osteoporosis in postmenopausal women who are at high risk of breaking a bone. Romosozumab-aqqg has a Boxed Warning in its product label, which advises that it may increase the risk of myocardial infarction (heart attack), stroke and cardiovascular death. It should not be initiated if a patient has had a heart attack or stroke within the preceding year or is otherwise high risk for a cardiac event.

**How is it taken?**

Romosozumab-aqqg is should be administered by a healthcare provider. Two separate subcutaneous injections, injected one after the other, are needed to administer the total dose of 210 mg. Injections should be administered once every month for 12 doses in the abdomen, thigh or upper arm.

**Are there side effects?**

The most common adverse reactions reported with romosozumab-aqqg in clinical trials were arthralgia (joint pain) and headache. Hypersensitivity reactions (including angioedema, erythema multiforme, dermatitis, rash and urticaria) may also occur. ONJ and unusual fractures of the upper femur (thigh bone) may also occur while taking romosozumab-aqqg. Patients should practice good dental care during treatment and should have an examination of the mouth by a doctor or dentist before starting the medicine.

**Nutrition**

**Calcium: An essential element for life**

Calcium is a mineral crucial to maintaining life. Nearly every cell in the body, including those in the heart, nerves and muscles, relies on calcium to function properly and bones require calcium to maintain their strength.

In the body, calcium is found in three places: in the skeleton and teeth, in the cells, and in the blood. Because calcium is so important, the body has a carefully regulated system to ensure that a good supply is always and immediately available.

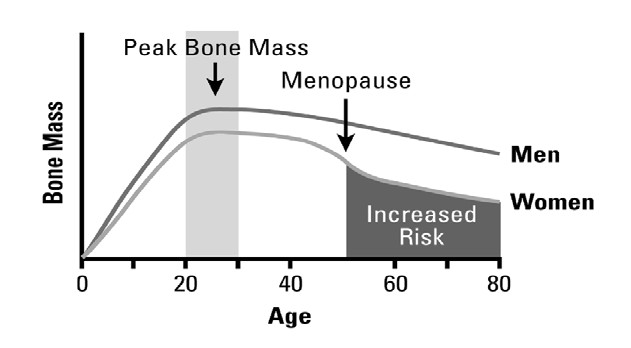
The body does this in three ways:

* It absorbs calcium directly from the food we eat.
* It takes calcium from our bones if there is not enough available. When this happens, the bones become less dense and more fragile.
* It slows down the amount of calcium that leaves the body in the urine by returning some to the bloodstream where it remains available to organs and cells.

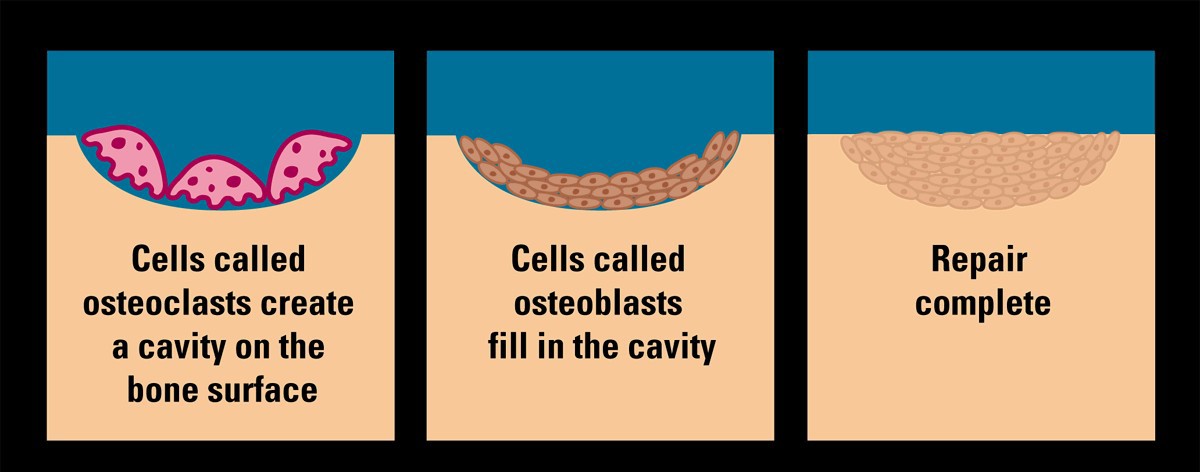
The main goal of good calcium nutrition is to maintain an adequate supply so that our bodies do not have to dip into our only calcium reservoir - our bones.

**The role of calcium in building stronger bones**

By age 20 in men and age 16 in women, bones typically stop growing in length and we are almost at our peak bone mass – calcium plays a large role in achieving that peak bone mass.



Bone is living tissue, constantly renewing itself. Although bone is strong and relatively flexible, everyday wear and tear causes tiny structural defects, much like those that occur in the foundations of a building over time. In our bodies, osteoclasts and osteoblasts are two groups of specialized cells that perform the work of a "maintenance crew.



As we age, the two groups of cells that form the maintenance crew become less efficient in working together - the osteoclasts remove old bone faster than the osteoblasts are able to rebuild it. In addition, calcium, like many nutrients, is absorbed less effectively as we age.

**Studies of older adults show that adequate calcium intake can slow bone loss and lower the risk of fracture.**

**How Much Calcium Do We Need?**

|  |  |
| --- | --- |
| **Age** | **Daily Calcium Requirement** |
| 4 to 8 | 800 mg |
| 9 to 18 | 1300 mg |
| 19 to 50 | 1000 mg |
| 50+ | 1200 mg |
| Pregnant or lactating women 18+ | 1000 mg |

**How to maximize calcium intake through diet**

* Get adequate amount of calcium every day
* Consult a reliable food chart:
  + NOF’s guide Food and Your Bones [nof.org/foods](http://nof.org/foods)
  + International Osteoporosis Foundation’s Calcium Calculator [iofbonehealth.org/calcium-calculator](http://www.iofbonehealth.org/calcium-calculator)

**Eat foods that contain calcium that is easily absorbed.**

Dairy products such as milk, cheese and yogurt are excellent sources of calcium because they contain high amounts of calcium that are easily absorbed by the body. Skim milk products provide as much calcium as whole milk with the added advantage of less fat and cholesterol. Some calcium-fortified soy beverages and orange juices may contain as much calcium as milk (check the labels). Vegetables also provide calcium, as do fish products containing bones (canned salmon and sardines) and meat alternatives such as lentils and beans.

**Dietary Calcium**

*It is preferable to get the recommended amount of calcium through diet first, since it’s often present alongside other nutrients, like vitamin D, that help bones with absorption.*

*Calcium supplements can then be used to fill in any gaps.*

**Calcium Supplements**

Calcium supplements are tablets, capsules or liquids containing the mineral calcium from a non- food source.

These sources include:

*Calcium carbonate*, which can be refined from limestone, natural elements of the earth, or may come from shell sources, usually oyster. Shell sources are often described on the label as a "natural" source. Calcium carbonate from oyster shells is not "refined" and can contain variable amounts of lead.

*Chelated calcium*, which refers to a special way in which calcium is chemically combined with another substance. Calcium citrate is an example of such a chelated preparation. Calcium may also be combined with other substances to form preparations such as calcium lactate or calcium gluconate.

Powdered bone (bonemeal) or dolomite, a mineral found in rock. (Bonemeal is not recommended, as it may contain contaminants).

**Calcium Quick Facts:**

*In determining how much calcium you are getting in a supplement dose, use the amount of ELEMENTAL calcium per tablet to calculate*

*Products which are derived from calcium CARBONATE are generally higher in elemental calcium*

*The body can only utilize 500mg of calcium at a time, so taking more than that in one dosage would be essentially wasted! (Spreading it out in the day is therefore recommended)*

**Vitamin D: A key factor in good calcium absorption**

The body makes vitamin D when exposed to sunlight. Since most don't always get enough sun exposure and it may be difficult to obtain necessary amounts of vitamin D through diet alone, supplements are generally a good idea. Vitamin D3 increases calcium absorption by as much as 30 percent.

The National Osteoporosis Foundation recommends:

**Americans aged 19 to 50**, including pregnant or lactating women, receive **400 – 800 international units** (IU) of vitamin D3 per day. **Adults over 50** should receive **800-1000 IU daily**.

***Vitamin D Quick Facts:***

*You can get 100IU of vitamin D3 in a 250ml glass of fortified milk*

*Most multivitamins provide 200IU of vitamin D3.*

*5-30 minutes of mid-day sun (in high sun months), twice a week, provides sufficient Vitamin D.*

**Exercise & Physical Activity**

**Physical Activity**

Physical activity is an important factor in the risk reduction and treatment of osteoporosis. Physical activity improves balance and coordination, which reduces the risk of falling or consequent fractures. In addition to improving strength, flexibility and posture physical activity can reduce pain and enable people with osteoporosis to perform activities of daily living.

Physical activity places an increased "load" or force on our bones. Bones respond by forming new bone and remodeling the existing bone to become stronger. Bones need to be stimulated by physical activity, it is necessary to be active in different ways in order to "load" or “stimulate” these bones and maintain their structural competence and strength.

In 2013, Dr. Lora Giangregorio from the University of Waterloo and a group of international experts developed the ‘Too Fit to Fracture exercise recommendations’ for individuals with osteoporosis or osteoporotic vertebral fracture.

The key points from this research is to develop multicomponent exercise programs that combine aerobic physical activity with balance and strength training to **prevent bone loss and falls for individuals with osteoporosis, or those with osteoporotic spine fractures.** These recommendations include expert opinions on how to move safely during every day activities, to avoid the risk of falls or spine fractures.10

There are four types of exercise and activity integral to the management of low trauma fracture and osteoporosis.

Your routine should include:

* Strength training
* Posture training
* Balance training
* Weight-bearing aerobic physical activity

**Key Messages: Exercise and Osteoporosis**

* Changes in posture, combined with changes in bone strength, can increase the risk of spine fracture. Poor alignment can be improved with exercises that target muscles important for posture.
* Poor alignment during daily activities may contribute to falls and fractures.
* In fact, spine fractures in older adults can occur during daily activities, like bending forward when putting on shoes.
* Aerobic physical activity, such as walking or dancing, has many health benefits. However, evidence suggests that balance and strength training should be emphasized as having the most benefit with respect to preventing falls, and bone loss. Aerobic physical activity should be combined with strength training and balance training to achieve the greatest health benefit.
* Performing exercises that challenge your balance **daily** can help prevent falls – even just a few exercises a day.
* Performing strength training exercises challenging most muscles of the body at least twice a week is recommended. With age, posture or body alignment can change, such that the spine is “hunched” or the head sits further forward than the shoulders. Individuals with osteoporosis can incorporate postural awareness into their daily life. Poor alignment can be improved with exercises that target muscles important for posture. Individuals with osteoporosis could consider practicing exercises that target “back extensor muscles” daily.
* The individuals at high risk of fracture should consider consulting a physical therapist with expertise in osteoporosis in order to design and execute an exercise program that reduces the risk of fracture

*Further detail on exercise and physical activity will be covered in Module 3.*

**Module 1 Reference List**

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