

The Spine Health Journal

National Spine Health Foundation

**Know Your Bones:
A Guide to Lifelong
Bone Health**

*Guest Editors:
Dr. Paul Anderson &
Dr. John Dimar*

**Maximizing Peak
Bone Mass**

**Your Osteoporosis
is Treatable**



The National Spine Health Foundation is a 501(c)(3) nonprofit organization dedicated to improving spinal health care through patient education, patient advocacy, and clinical outcomes research.

Publication of The Spine Health Journal is made possible through the broad range of philanthropic individuals, corporations, and foundations that believe in our mission. We educate patients and the public about the treatment and prevention of neck and back disorders with unbiased, expert-driven educational resources, supporting patients through peer-to-peer connection on their journey to spinal health. This Journal aims to provide a deeper understanding of the science of spine care technology and techniques, serving as a bridge toward knowledge and hope for anyone suffering from spine problems. We are grateful to members of the Spine Health Leadership Council, including Amgen and UCB, whose support helps make this and many of our programs possible. If you would like to make a donation in support of our mission, please visit spinehealth.org/donate, or email us at give@spinehealth.org. When you support the National Spine Health Foundation, you fuel initiatives that are not just crucial but transformative for patients, health care providers, and the entire spine health industry. Join us in changing the future of spine health for the better.

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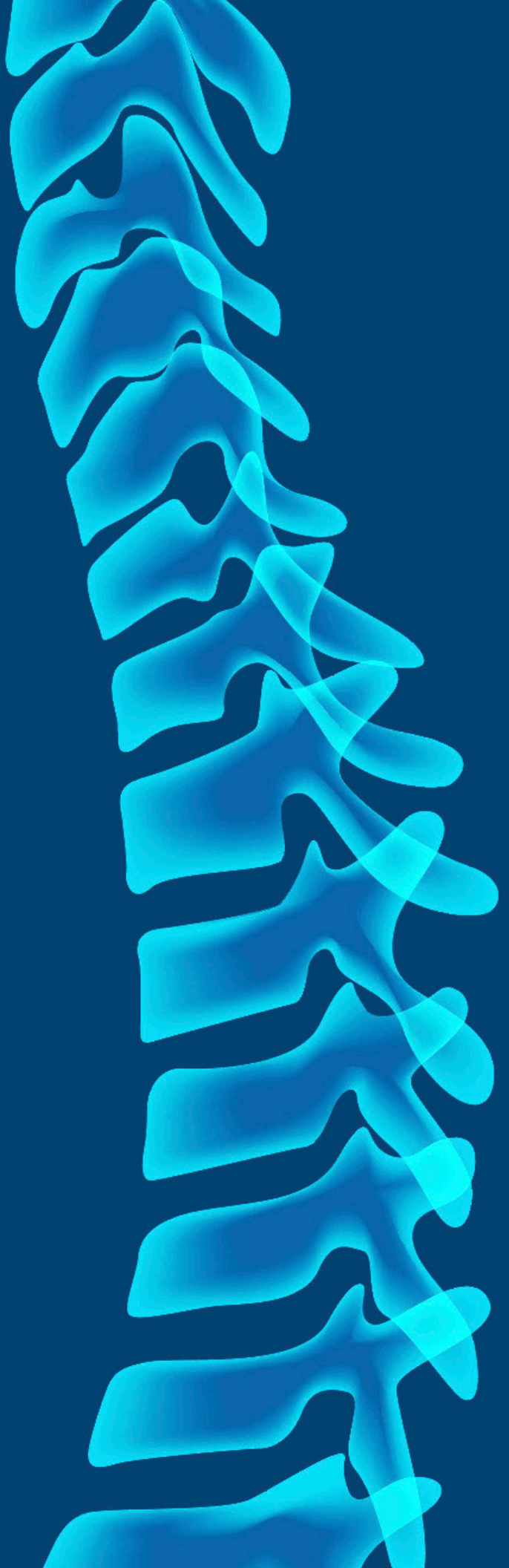
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Introduction

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An Introduction from Rita Roy, MD

CEO, NSHF



Did you know that there is a global epidemic of poor bone health and osteoporosis? There are 54 million Americans that have low bone density or osteoporosis, highlighting the need to **Know Your Bones**, which is what this issue of The Spine Health Journal is all about!

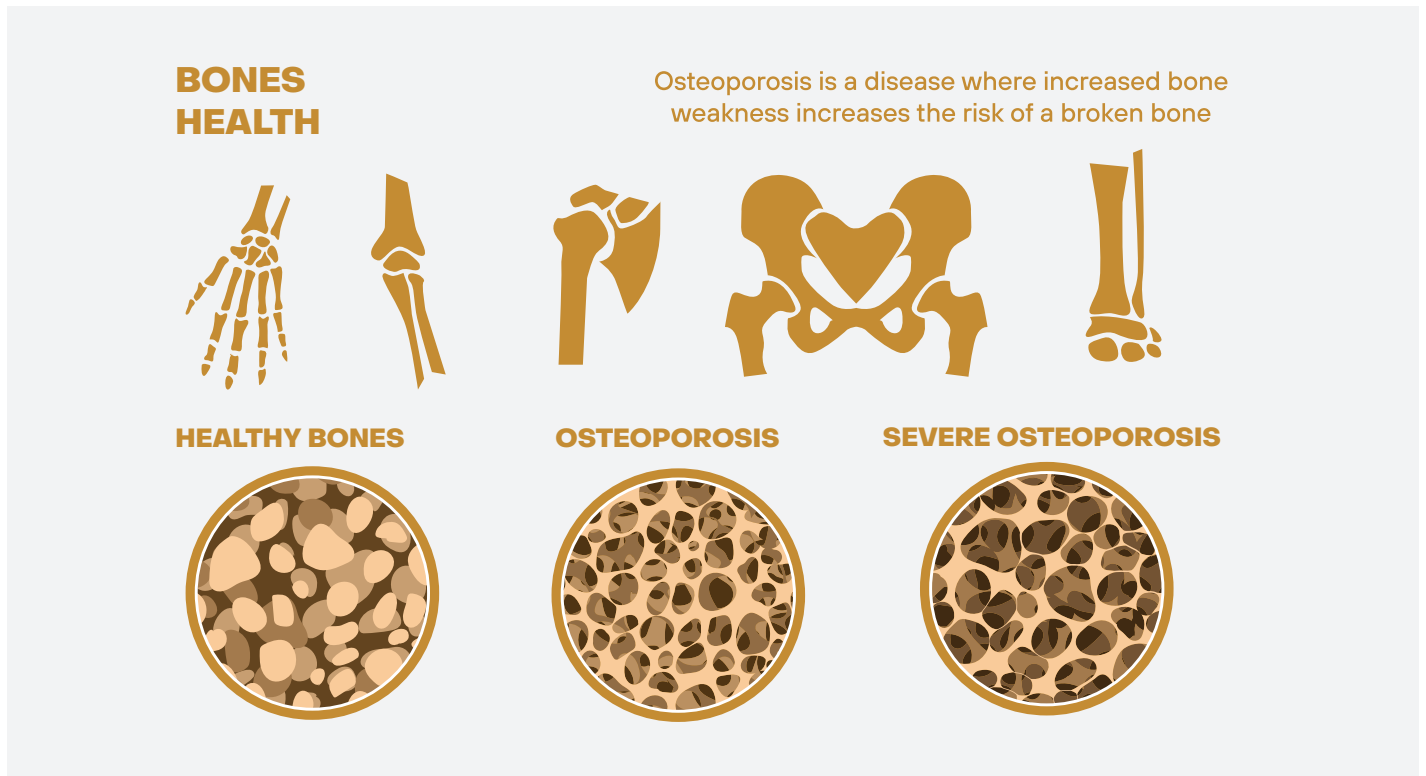
Bone health is a topic for **EVERYONE**. No matter your age, race, or gender, thinking about the health of your bones and taking action to preserve it is critical to life. Society tends to overlook the needs of our skeletal system, so now is the time to be our own advocates for bone health. Our aim is to bring this routine health maintenance topic to the forefront of your mind, like going to the dentist twice a year or having regular eye exams.

Did you know that fractures in the spine occur an estimated 1.5 million times each year in the U.S., which can lead to early death? A shocking 1 in 2 women and up to 1 in 4 men over the age of 50 years will break a bone due to osteoporosis. These fractures are often related to a simple slip and fall (low energy) accident, rather than a high energy trauma like a car accident. In severe cases, even coughing and sneezing can lead to fractures. Yet, with the proper evaluation and

management, many of these fractures can be avoided!

Because of the epidemic in bone health, and because debilitating fractures from osteoporosis occur most often in the spine, the National Spine Health Foundation (NSHF) has created the Spine & Bone Health Task Force. The Task Force is working hard to raise awareness about the critical need to care for your bones – whether you're a spine patient or not! We are grateful to the world-class experts serving on our Task Force and the generosity they are giving to NSHF through voluntarily contributing their knowledge to educate everyone.

The Spine & Bone Health Task Force is chaired by two of the world's foremost experts on spine, musculoskeletal health, and bone health. Dr. Paul Anderson from the University of Wisconsin is a widely recognized pioneer in this field. Dr.



Osteoporosis Stages

Anderson’s vision as a spine surgeon treating osteoporosis spans his forty-year clinical career, earning him the Lifetime Achievement Award from the Cervical Spine Research Society in 2022. Dr. Anderson is perhaps the most widely-published authority on spine and bone health in the world, with hundreds of peer-reviewed articles, book chapters, books, abstracts, and professional presentations.

Co-chairing the Task Force is Dr. John Dimar from Norton Leatherman Spine Center in Louisville, Kentucky. In his impressive 32-year clinical career, Dr. Dimar has been actively engaged in clinical research with hundreds of publications in musculoskeletal health. He has been the recipient of both Best Clinical Paper and Best Research Paper awards, which demonstrate the high quality of his work and leadership in the field.

Together, Drs. Anderson and Dimar lead the impressive Task force team consisting of Dr. Venu Nemani, Dr. Brandon Carlson, Dr. Ben Elder, Dr. Ganesh Shankar, and Dr. Zeeshan Sardar and are both Guest Editors of this issue of The Spine

Health Journal. You will find exceptional articles throughout this issue authored by this group of remarkable surgeons, eager to share their expertise with you.

Knowledge is power. Understanding bone health has the potential to be life-changing if some basic steps are taken, which you will read about in this issue. We are grateful to the contributions of our Guest Editors and all our Task Force volunteers, whose contributions make our mission of improving spinal health for everyone possible.

Finally, we are grateful for collaborative support from our Spine Health Leadership Council Gold Members, UCB and Amgen, whose participation helps make this publication possible.

Here’s to strong bones, healthy spines, and good living!

- Rita Roy, MD

Letter From the Guest Editors

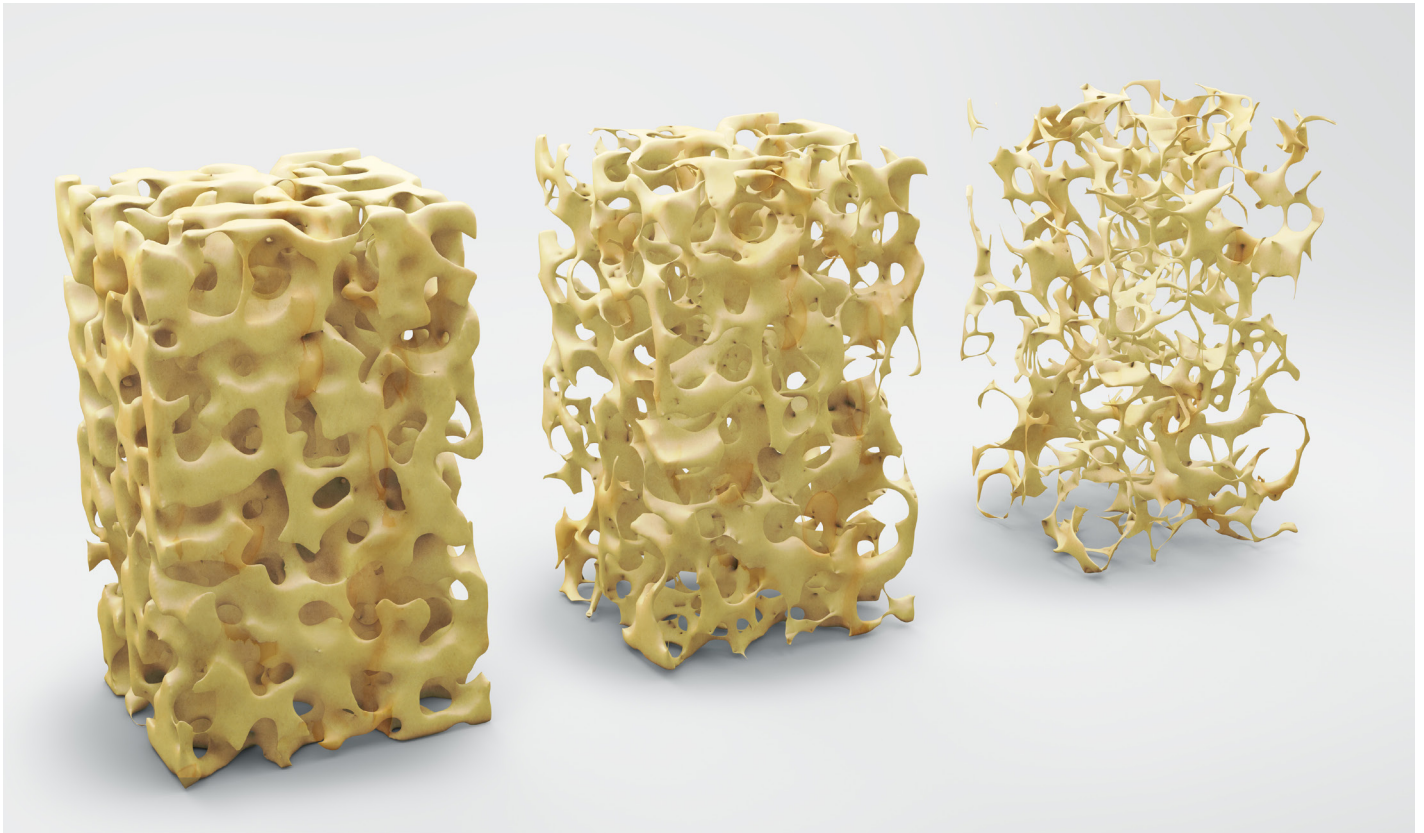
Paul A. Anderson, MD, University of Wisconsin
John R. Dimar, MD, Norton Leatherman Spine Center

Osteoporosis and spine surgery

Bone is constructed from proteins, bone cells, and a mineral called hydroxyapatite. The bone is dynamic, constantly being remodeled by processes that break down bone followed by bone formation. When bone loss is greater than formation, the bone structures become thinner, resulting in a greater likelihood of fracture. The spine is particularly prone to bone loss, accounting for why it is the most common site of fracture. In addition, alterations in protein from medical or nutritional diseases can lead to increased fracture risk. Vitamin D is deficient in most people and is required for mineralization of bone, which is why it is essential that you have appropriate Vitamin D intake as described in this journal.

Osteoporosis is diminished bone mineral density and bone quality resulting in increased fracture risk and, in the case of spine surgery, also poorer results. Osteoporosis is associated with many risk factors that would prompt further diagnostic testing. One important factor is any history of having a fracture after the age of 50. Future fracture risk is used to diagnose osteoporosis and to determine who needs treatment and which treatment is best for you.





Modeled representation of the bone weakening of osteoporosis

The most common diagnostic test is a DXA bone scan which is a safe, relatively low cost, and low radiation procedure that provides a measurement of bone mineral density. Interpretation of DXA can be confusing but is explained in this issue. Also, at the time of DXA your 10-year fracture risk is estimated and used to determine if medication to treat osteoporosis is warranted. It is important for individuals older than 50 years to ask your provider if a DXA should be obtained and whether you are at risk for osteoporosis.

The diagnosis and treatment recommendations have recently changed. In the past, DXA was used as the only criteria. However, more recently, a history of fracture of the spine or hip or a high 10-year fracture risk confirms the presence of osteoporosis and the need for medical treatment. Unfortunately, many medical providers do not realize these changes and often insurance carriers ignore them, leaving many patients who need osteoporosis treatment untreated.

If you have osteoporosis, there are many options for treatment that are highly effective. Two

types of medications exist, one that slows bone breakdown and the other which builds bone. All types of medication significantly reduce fractures and have the added benefit of maintaining quality of life and independence. In patients about to undergo elective spine surgery, they also can reduce complications and risk for revision surgery. The choice of medication needs to be discussed on an individual basis.

You also need to consider lifestyle changes that promote better bone health and reduce the risk of fractures. If you are underweight (BMI < 18.5), then you have an increased fracture risk and should undergo nutritional assessment and counseling. Consumption of bone harming substances such as any tobacco products and excessive alcohol should be discontinued. Weight bearing exercise such as simple walking or activities like Tai-Chi can help maintain bone mass. If you have fallen in the last 6 months, you should let your medical provider know, as you are at risk for further falls and harmful fractures. Adult patients should consume 1000-2000 IUs of Vitamin D3. In addition, the recommended daily calcium consumption is 1200

mg, which is best consumed through your diet, but you may need calcium supplements.

Patients who have spine fractures after the age of 50 should be considered as being osteoporotic and therefore may be candidates for medical therapy. Unfortunately, less than 20% of patients undergo bone health assessment, and fewer are offered medical treatment in North America. Despite fears of medication side effects, medical treatment of osteoporosis is highly effective, yet there remains a huge treatment gap. You should request further diagnostic studies and consider medical treatment if you have had a fracture. If you have had treatment for compression fractures, such as kyphoplasty or vertebroplasty, this is even more important to discuss with your medical provider, as medical treatment has been shown to reduce future fracture risk by 60% to 80%.

Optimizing medical conditions is essential to improve results and reduce chances of complications after spine surgery. Bone health has been gaining interest due to the recognition

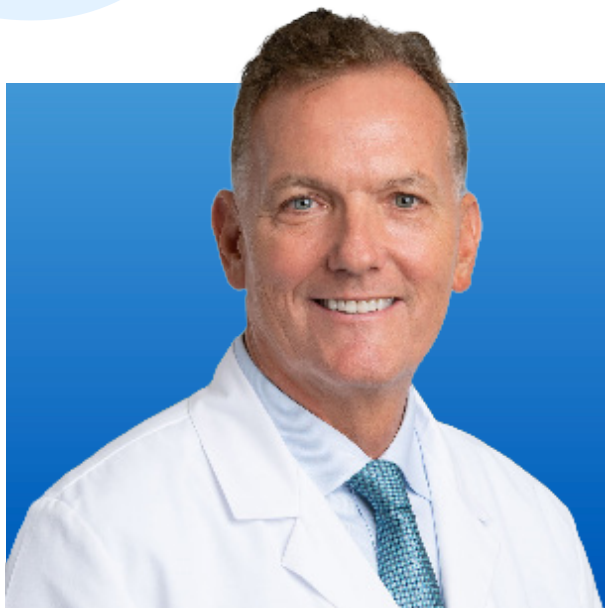
that brittle bones (also known as osteoporosis) are associated with surgical failure, bone-related complications, and need for further surgery. Preoperative assessment and optimization of bone health is increasingly being performed to address these issues. If you have concerns about your bone health, have risk factors for osteoporosis, or have had recent fractures, then you should request further evaluation and treatment if indicated prior to surgery, even if a surgical delay is necessary.

This issue of the Spine Health Journal contains a wealth of information on the topic of bone health and optimization. Each article expands on the topics introduced here and is written by an expert in spine surgery and bone health. We hope that you take away this valuable information and discuss these topics with your medical providers and your family members. Bone health is for everyone.

**- Paul A. Anderson, MD, &
John R. Dimar, MD**

“

Unfortunately, less than 20% of patients undergo bone health assessment, and fewer are offered medical treatment in North America.”



President's Note

Thomas C. Schuler, MD, FACS
The Virginia Spine Institute

Cycle of Health

How do we optimize our health? Is it losing weight? Exercising more? Eating healthy? We create resolutions with the desire to improve our health, yet are they effective and, perhaps more importantly, are they sustainable? To achieve optimal results, improved health, and quality of life, we need our efforts to produce both short and long-term benefits.

The first step is understanding that our health is dependent on multiple factors and that these factors interact on a continuum. You cannot ignore one part and expect overall success. The next step is understanding what components make up the cycle of health. I break these components into **DREAMS: diet, replenish fluids, exercise, avoidance, mental health, and sleep**. Each of these items impact all the others, so let's look at our health as a deeply-interconnected cycle.

Diet

Diet is critical to well-being. The adage, "you are what you eat," speaks a lot of truth. Healthy management of natural foods that come directly from plants and animals is the starting point. Processed foods have added chemicals that are disruptive to our health, our immune system, bone health, body fat, and significantly impact our gut flora (the healthy bacteria needed to keep our GI tract healthy). In fact, many

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It is essential to understand not only what we are eating but how much we are eating.”



items that tempt us, such as (1) processed foods, (2) sugary and diet sodas, and (3) other chemically enhanced beverages can all negatively impact our gut flora, including some medications. These can jeopardize our weight, immune status, and mental status. Probiotics can improve the negative GI effects of medications.

Vitamins are an insurance policy to fill in any nutritional holes in our diet. In our hectic lives today, eating a properly balanced meal daily is often difficult, so think of vitamin supplements as a stopgap for better homeostasis in our nutritional quest. For example, if you don't spend enough time in the sun causing low Vitamin D levels, then Vitamin D supplements will support bone health.

Although many diet fads come and go, a balanced diet of carbohydrates, proteins, and fats is needed to support our health cycle. The issue is that most snack foods are simple carbohydrates which rapidly impact our blood sugar, insulin levels, and cause weight gain. Limiting how much one eats is also important. Portion control can be difficult especially in this supersized world. It is essential

to understand not only what we are eating but how much we are eating.

Replenishing fluids

Replenishing fluids sounds obvious, but most people do not drink enough water during the day. We need to stay hydrated to support all our bodily functions. In addition to the fluids we get from our diet and other drinks, we should be drinking 6-8 cups of plain water every day. This will support our exercise performance, cognition, mood, and sleep quality.

Exercise

Exercise impacts the cycle of health directly and indirectly. To maintain our cardiovascular health, mental health, and musculoskeletal health, we need an exercise program that is comprised of (1) aerobic, (2) anaerobic, (3) endurance, (4) strength, and (5) flexibility training. By hitting all these components, we improve our bone strength, mobility, and cardiac fitness. The indirect effect comes from increasing the production of

endorphins, which help relieve pain, reduce stress and anxiety, and improve our sense of well-being. Walking outdoors is a weight-bearing activity that most people can participate in, and is a great way to clear the mind, solve problems, and stimulate bone strength. Exercise and mental clarity enhance our sleep, highlighting its importance in the cycle of health.

Avoidance

Avoidance is very important because behaviors in this category are often the most detrimental to our health. The single best thing you can do for your long-term health is complete nicotine abstinence. Nicotine impairs tissue health, tissue healing, and bone health. It impairs the ingrowths of new blood vessels into the injured tissues, which creates an anoxic local environment that inhibits healing. Illicit drug use and overconsumption of alcohol are also critical areas to abstain from. These activities impair our health directly as well as indirectly through impaired exercise, bone health, mental well-being, and quality of sleep.

Mental health

Mental health and our state of mind are often overlooked as important contributors to our health cycle. The mind is impacted by internal and external factors; some we can control and some we can't. The key in the cycle of health is to control what you can. Mental health must be supported by (1) eating healthy food to supply the brain with nutrients, such as fish oil, (2) obtaining quality sleep allows your mind to achieve a restful state, (3) avoiding nicotine, drugs and excessive alcohol are all critical for our

mental well-being, and (4) exercising improves blood flow and burns off stress. Other activities such as dedicated mindfulness, reading, and socializing all improve our mental state, which provide an escape from our busy and stressful lives each day. Mental health is not a passive process but a very active process.

Sleep

Sleep is the final component of the cycle of health. We need to heal and recover our physical and mental wellness, which can be accomplished simply by the magical elixir of sleep. Quality sleep is required to remove toxins from our brain and heal our bodies. This gives us the mental clarity and physical energy to have a successful next day. This becomes apparent if you recall how hard a day is physically and mentally when you do not get enough sleep the night before. What we consume and our activities impact our sleep routines and the enjoyment of the next day. These components of the health cycle are all interconnected.

During this time of New Year's resolutions, let's enjoy better health by focusing on building sustainable practices that positively impact all aspects of the cycle of health. As you strive for new goals and perspectives, just remember each day is a new day and another chance to build your optimal cycle of health. Have a wonderful and healthy 2024 and remember your **DREAMS**.

- Thomas C. Schuler, M.D.

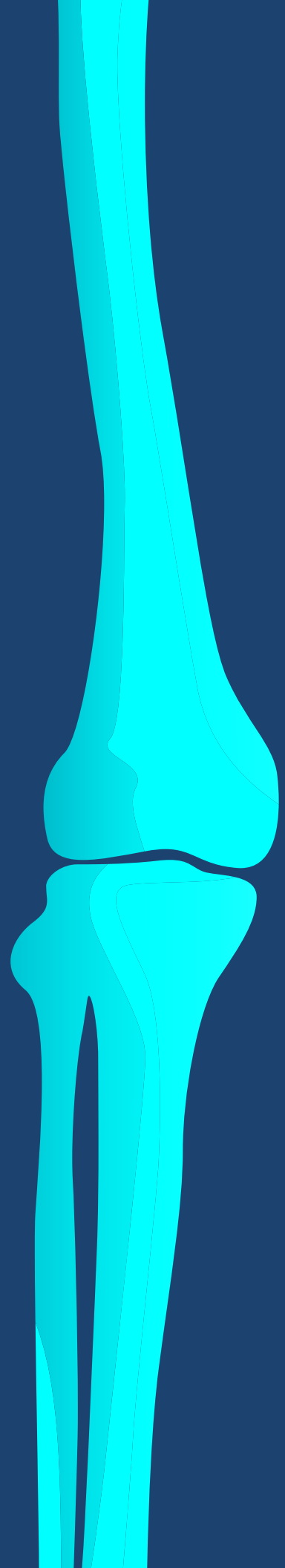


" NEW YEAR "
RESOLUTIONS

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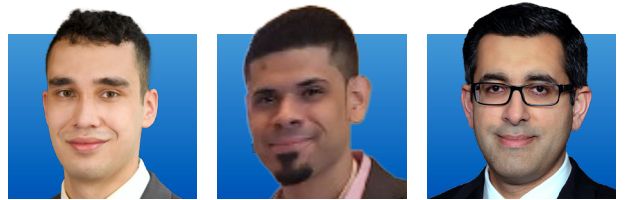
Section 1

12. *Our Amazing Bones: Bone Health Basics*



BONE HEALTH BASICS

Our Amazing Bones



Anson Bautista, MD, Justin Reyes, MS, Zeeshan Sardar, MD
Columbia University Och Spine Hospital at
New York-Presbyterian/Allen

Bone health is an essential component of overall well-being. The skeleton not only offers support and protection but also enables vital physiological functions that are essential for our everyday lives. This article **explains** the intricate world of bone health and **explores** the functions of the skeleton and the role of calcium metabolism. Maintaining optimal bone health is a multifaceted process involving genetics, age, and nutrition, and highlights the importance of an active lifestyle. Basically, the skeleton has three major functions: structural support, blood formation and maintaining calcium metabolism.

Three Major Functions

The primary function of the skeleton is to provide **structural support** serving as the body's

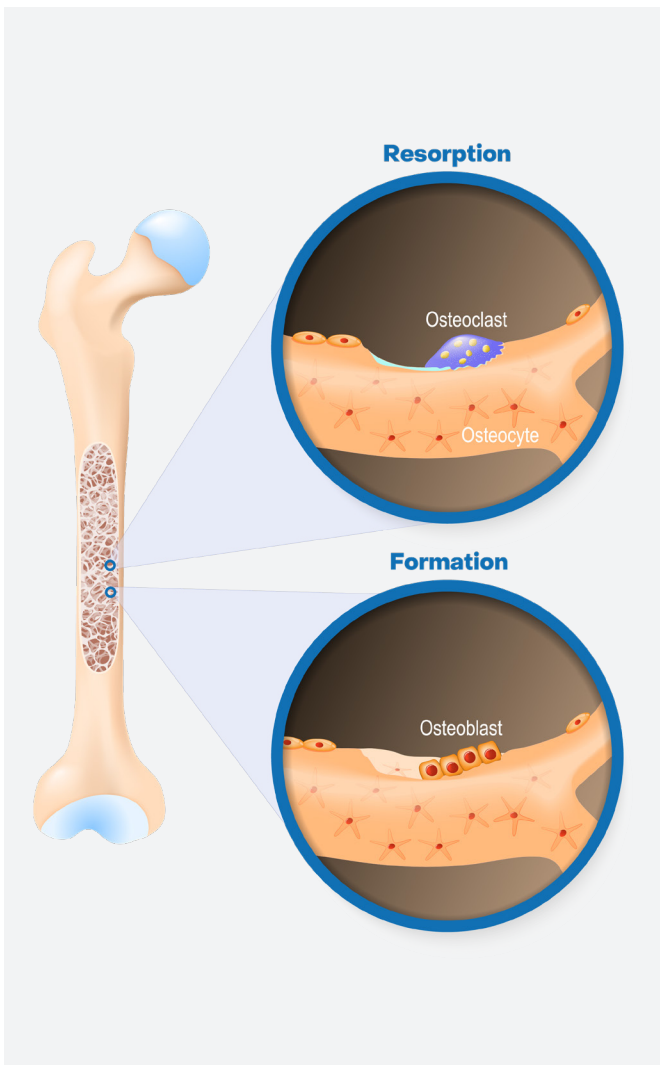
foundation. It acts as a safeguard for vital organs, such as the brain and heart. The bones, along with the joints, play a pivotal role in facilitating movement by providing a sturdy and resilient framework that allows us to stand, ambulate, and engage in various physical activities. The spine is the central pillar, supporting the body's weight and maintaining an upright posture.

The second major function of the skeleton is to provide the necessary reservoir for **hematopoiesis** – the production of blood cells. The bone marrow is the site for the formation of red blood cells, white blood cells, and platelets. This hematopoietic reserve ensures a continuous supply of blood cells necessary for oxygen transport, immunological response, and blood clotting.

The third major function of the bone is the **regulation of calcium metabolism**. The physiology of bones is a dynamic and continuous process involving a delicate balance between bone formation and resorption. **Osteoblasts**, specialized cells responsible for bone formation, synthesize the bone matrix and contribute to its mineralization. In contrast, **osteoclasts**, cells involved in bone resorption, break down bone tissue, releasing minerals into the bloodstream. This balance ensures that bones can adapt to the changing needs of the body.



Maintaining optimal bone health is a multifaceted process involving genetics, age, nutrition, and highlights the importance of an active lifestyle.”



Calcium is vital in maintaining healthy bone quality and is intricately involved in many of the body's important physiologic processes. Our bones serve as a reservoir, maintaining a precise calcium equilibrium within the bloodstream that is regulated by the parathyroid gland hormones. The body stimulates bone to release or absorb calcium causing the calcium levels in the blood to rise or fall.

Proper calcium metabolism is essential for maintaining bone health throughout life. Insufficient calcium intake or impaired calcium metabolism can lead to a condition known as **osteoporosis**, characterized by weakened and fragile bones. This condition significantly increases the risk of fractures, which can be devastating later in life, and compromises overall skeletal integrity.

Bone Health Influencers

The health of our bones is influenced by a combination of genetic and environmental factors. Bone density tends to deteriorate with **age**, and fracture risk rises. Women are more likely to experience this phenomenon because of **hormonal changes** that impact calcium metabolism, particularly during and after **menopause**. Genetic predisposition also plays a role in bone health, as some individuals have a tendency to conditions such as osteoporosis. Understanding one's **genetic predisposition** can help in adopting proactive strategies and timely interventions aimed at preserving optimal bone health.

Peak bone mass is typically reached during early adulthood, which emphasizes the importance of building strong bones during childhood and adolescence. But it is never too late to begin incorporating bone healthy habits into your life! Adequate **calcium** intake, along with sufficient **vitamin D3** levels, **phosphorus**, **magnesium**, and other **micronutrients**, is crucial for optimal bone mineralization. Smoking cessation and avoiding any nicotine intake is important for improving bone health at any age. Lifelong physical activity that includes **weight-bearing exercises** promotes bone formation by stimulating osteoblast activity.

Fortify Your Spine!



Balance your plate with calcium, magnesium, and vitamin D – found in leafy greens, nuts, and fatty fish.



However, a sedentary lifestyle or conditions that lead to hormonal imbalances can tip the balance toward increased bone resorption, compromising bone health.

Take Home Message

In conclusion, our bones are amazing, and dietary intake, genetics, nicotine, alcoholism, chronic illnesses, and other physiologic processes intricately interact to determine bone health. Make a point to discuss your bone health during the next physical with your healthcare provider. They should have a thorough understanding of bone physiology and the importance of appropriate treatment regimens that are paramount to help you maintain optimal bone health throughout life.

Embrace a proactive approach that includes a balanced diet, regular exercise, lifestyle

changes and awareness of your family history of osteoporosis. Individuals can take significant steps toward preserving the strength and integrity of their bones by investing in their own bone health, thus improving their overall well-being and quality of life.

Section 2

16. Bone Health Optimization



Bone Health Optimization

*Brandon Carlson, MD, MPH
University of Kansas Medical Center*



Optimizing bone health is crucial for overall well-being, as the skeletal system plays a pivotal role in maintaining the structural integrity of the body. From providing support and protection to facilitating movement, healthy bones are essential. This article provides a blueprint of key strategies to optimize your bone health.

Nutrient Rich Diet

Our diets are increasingly recognized as a key driver of our health across all body systems. A well-balanced diet rich in essential nutrients is fundamental for bone health. Calcium, phosphorus, magnesium, and Vitamin D are particularly vital. Dairy products, leafy greens, nuts, seeds, and fortified foods contribute to a robust bone-friendly diet.

Calcium Intake

Calcium is a cornerstone for bone health, constituting a significant portion of bone structure. Incorporate dairy products, such as milk and cheese, or opt for non-dairy sources like fortified plant-based milk, tofu, and leafy greens. Maintaining enough calcium intake through dietary sources is important for preventing your body from breaking down your bones to maintain a proper level of calcium in your body.

Vitamin D3 Intake

Vitamin D3 plays a pivotal role in calcium absorption. Sunlight is a natural source of this vitamin, and spending time outdoors can contribute to properly maintaining Vitamin D3 levels in your body. Additionally, include fatty fish, fortified cereals, and egg yolks in your diet to keep Vitamin D3 levels optimized, especially during the rainy season or winter months.

Calcium & Vitamin D3 Supplementation

While dietary and natural sources of calcium and Vitamin D3 are recommended, some patients may still need additional supplementation to reach adequate intake goals. Consult with a healthcare professional to determine if supplements are needed. Proper dosing and monitoring blood levels is often necessary when supplementations are started.



Sunlight is a natural source of this vitamin, and spending time outdoors can contribute to properly maintaining Vitamin D3 levels in your body.”



Exercise

Weight-bearing exercises, including walking, jogging, and resistance training, stimulate bone formation and help maintain bone density. Maintaining regular, moderate-intensity exercise promotes bone health maintenance.

Avoid Nicotine & Limit Alcohol

Nicotine is linked to decreased bone density, and excessive alcohol consumption can interfere with bone formation. Quitting smoking/vaping and moderating alcohol intake significantly contribute to overall bone health.

Maintain a Healthy Body Weight

Being underweight or overweight can adversely affect bone health. Strive for a balanced weight through a combination of a healthy diet and regular exercise to support your bones. Your primary care physician can discuss your optimal body weight and composition with you and how to achieve your desired weight goals.

Osteoporosis Screening & Surveillance

Annual health exams including screening for diseases are critical for early detection and treatment. This is especially important for osteoporosis screening and identifying low bone mineral density. DXA bone scans are performed to monitor bone density. Typically, women over 65 years and men over 70 years of age should have DXA screening performed. However, in the presence of risk factors for low bone density, such as certain other diseases and medications that accelerate bone loss, earlier DXA screening is imperative to early detection and treatment.

Fracture Prevention with Medications

The mainstay of avoiding fractures is early prevention of bone loss and maintenance of bone health, so asking your health care provider to evaluate your bone health status is important. Once a patient is diagnosed with either osteopenia or osteoporosis, a health care provider may initiate additional medications to help prevent fragility fractures (low energy fractures). These



medications can either help prevent further bone loss and/or increase bone density & quality. Which type of medicine is right for each patient is multi-factorial and should be determined by the health care provider.

Bone Health & Musculoskeletal Surgeries

Musculoskeletal surgeries such as spinal fusions, total joint replacements, or fracture repairs are directly impacted by bone health. Patients with osteoporosis or poor bone health are at much higher risk for surgical complications. Spine surgeons and orthopedic surgeons now routinely evaluate and screen for bone health concerns prior to elective surgeries. In some scenarios, if low bone health is identified, pre-operative

treatment to increase bone density/quality is initiated to try and prevent surgical complications.

In conclusion, optimizing bone health is a multifaceted approach that involves a combination of a nutrient-rich diet, regular exercise, lifestyle modifications, and periodic health check-ups. By incorporating these strategies into your daily life, you can enhance and maintain the strength and resilience of your bones, contributing to a healthier and more active life.



Section 3

20. Bone Health Assessment



Bone Health Assessment

*Olga Klachkovich, PA-C &
Venu M. Nemani, MD, PhD
Virginia Mason Medical Center*



Osteoporosis is a common condition that is characterized by a low bone mineral density leading to increased risk for fractures (broken bones). Your healthcare provider can use several diagnostic tests and tools to screen for osteoporosis. The three tests reviewed below complement a complete history and physical examination, which includes blood work to assess your clinical risk factors.

DXA

Dual energy x-ray absorptiometry (DXA), provides a measure of bone mineral density by passing both high-energy and low-energy x-ray beams through various parts of your skeleton, usually your hip (proximal femur), spine, and sometimes your forearm/wrist (distal radius). This is the

Everyone should discuss a
DXA scan with their doctor if they're

over 50
or if they have a

family history
of osteoporosis



most common noninvasive screening test for osteoporosis that is quick, painless, and with low exposure to radiation. DXA scans should be repeated once every 2 years or sooner if there has been a clinical change that might adversely affect bone density (e.g. starting chronic high-dose steroids).

DXA reports bone density as a “T-score,” which compares your bone density to that of a healthy young adult. A T-score above -1 indicates normal bone, a T-score between -1 and -2.5 indicates osteopenia, and a T-score less than -2.5 indicates osteoporosis. The lower your score, the weaker your bone. It is important to note that if you have suffered a fracture due to a fall from a standing height or a similar low-energy injury, then by definition you have osteoporosis regardless of your T-score on a DXA scan.

DXA scans can be done at most radiology imaging centers and can be ordered by your primary care provider or specialty providers such as a physiatrist, endocrinologist, or your spine surgeon. Screening with a DXA scan should be considered in:

1. All post-menopausal women 65 years or older
2. Men greater than 70 years old
3. Men and women 50 years or older with known risk factors for osteoporosis, such as:
 - Smoking/nicotine use
 - Vitamin D deficiency
 - Prolonged use of steroids
 - Family history of osteoporosis or a parent with hip fracture history
 - Malabsorption
 - Chronic illnesses

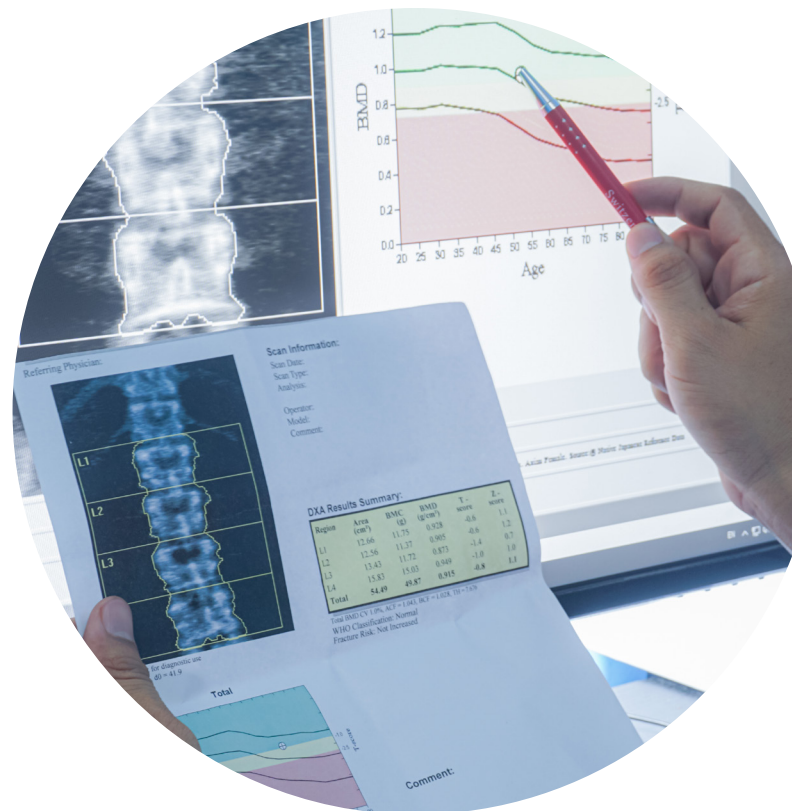
Additionally, we strongly recommend screening with DXA in all patients who are being considered for spinal fusion surgery (especially multi-level spinal fusion) who have risk factors or fracture history, so that low bone density can be optimized pre- and post-operatively if identified. This can

significantly lower the risk of osteoporosis-related complications, surgical failures, and the potential need for revision (redo) surgery.

Finally, a lateral spine X-ray can be obtained at time of DXA (called vertebral fracture assessment or VFA) which is used to identify occult spinal fractures. This is especially important in patients about to undergo spine fusion.

FRAX

There are several online tools and calculators that allow you or any clinician to input your clinical information and estimate your personal risk for osteoporosis or risk of fractures. One of the best tools available to assess fracture risk is called the FRAX calculator (<https://frax.shef.ac.uk/FRAX/tool.aspx>). This tool gathers responses to 12 questions related to your clinical risk factors including age, gender, weight, smoking history, alcohol use, and other factors that can affect your bone health. It can



DXA report of the spinal region

Figure 1

Country: **US (Caucasian)**
Name/ID:
About the risk factors

Questionnaire:

1. Age (between 40 and 90 years) or Date of Birth

Age: Date of Birth: Y: M: D:

2. Sex Male Female

3. Weight (kg)

4. Height (cm)

5. Previous Fracture No Yes

6. Parent Fractured Hip No Yes

7. Current Smoking No Yes

8. Glucocorticoids No Yes

10. Secondary osteoporosis No Yes

11. Alcohol 3 or more units/day No Yes

12. Femoral neck BMD (g/cm²)

T-Score

BMI: 20.5
The ten year probability of fracture (%)

Major osteoporotic	33
Hip Fracture	21

be used by anyone at home, with or without DXA data. It provides you with a 10-year probability of a hip fracture and a 10-year probability of a major osteoporotic fracture (fracture in your spine, hip, shoulder, or forearm). These fractures can be devastating and significantly impair one's quality of life.

FRAX results are expressed in percentages. A 10% risk of a hip fracture, for instance, would mean that 10 out of 100 people with the same risk profile as you will develop a fracture in the next 10 years. If your FRAX results give you a 10-year probability of a hip fracture > 3%, or major osteoporosis-related fracture > 20%, then you should talk to your healthcare provider about starting prescription medications to treat your osteoporosis. Calcium and Vitamin D are not enough to lower your risk of fracture in these cases!

Figure 1 is an example of the important additional information the FRAX tool provides. In this case,

the person's DXA results (T=-2.1) put them in the category of osteopenia (no need for prescription treatment), but FRAX results considered their clinical risk factors and put them at high risk for fracture (prescription treatment needed).

Opportunistic CT Scans

Another way your provider or spine surgeon may diagnose low bone density is by using information from a CT scan you've already had, called an "opportunistic CT scan." A CT evaluation of your lumbar or thoracic region may be requested by your spine surgeon as part of the pre-operative planning process for spine surgery. From that CT scan, your surgeon can additionally measure what are called "Hounsfield Units" (HU). This evaluation provides a measure of local bone density that can be specific to the spinal levels where you may be having surgery, rather than a regional evaluation of bone from DXA. Generally, an HU below 110 correlates with the presence of osteoporosis.



Your provider can measure HU numbers not only from a dedicated spinal CT study but also from a CT of the chest, abdomen, or pelvis that may have been ordered for other clinical reasons. Although HU measurements alone cannot be used to diagnose osteoporosis, when combined with other clinical and diagnostic data, they can support the approval of osteoporosis treatment if your surgeon or primary care provider deems it necessary for optimization of your bone health.

Summary

Poor bone health is a common medical problem without obvious symptoms to prompt you to seek workup and treatment until late in the disease process when fractures occur. The three tools described in this article are noninvasive and can provide a wealth of knowledge for you both

now as a baseline and in the future as your bone health changes. Adults, particularly those with risk factors, should be proactive in asking their healthcare providers to evaluate their risk of osteoporosis by these easy and effective clinical tests so that education and the appropriate treatments can be initiated expediently.



Adults should be proactive in asking their healthcare providers to evaluate their risk of osteoporosis.”

Section 4

*25. Your Osteoporosis is Treatable:
Medication Options Explained*



MEDICATION OPTIONS EXPLAINED

Your Osteoporosis is Treatable

John R. Dimar, MD
Norton Leatherman Spine Center



Osteoporosis is a disease of the bone characterized by a loss of density, mass, and strength that is often a silent disease until fractures occur. Osteoporosis can lead to severe disability since it weakens the skeleton to the point where simple activities of daily living may result in catastrophic fractures. Osteoporosis becomes more common in the sixth decade of life but can occur at any age, particularly in those with chronic diseases. Perhaps because patients with osteoporosis remain asymptomatic for many years causing it to be underdiagnosed, the treatment of osteoporosis has lagged behind other disease treatments and has been insufficient except when treating the resultant fractures with surgery.

The Good News

Fortunately, over the past two decades there has been great progress with numerous new medications developed that have dramatically improved the ability of health care professionals to successfully treat osteoporosis, resulting in a decreased chance of suffering an osteoporotic bone fracture. Osteoporosis may affect all skeletal regions, progressively weakening the bone's strength, resulting in fractures of the spine, hips, shoulders and forearms. Once osteoporosis has been diagnosed, these medications, when combined with Vitamin D3, calcium, lifestyle changes, exercise



and diet can not only decrease the loss of bone from the skeleton, but certain medications increase bone strength and prevent fractures.

This article will provide detailed information on the various classes of medications for the treatment of osteoporosis, medication names (generic and brand names), how they are administered, the recommended length of treatment, possible side effects, and their expected effect on bone health. We are fortunate in this day and age to have several to discuss.

Osteoporosis Medications

There are five major types of medications available for the treatment of osteoporosis found in the summary table of medications for osteoporosis. These medications work in two basic ways, by **(1)** decreasing the progressive loss of bone and slowing the loss of the skeleton's integrity (referred to as catabolic drugs or inhibitors of bone resorption) or **(2)** building bone mass (referred to as anabolic drugs or stimulators of bone formation) resulting in an improvement of the skeletal strength.

These medications are administered in a variety of methods including by mouth, intravenously and by subcutaneous injection, and dosage schedules may be daily, weekly, monthly, or biannually depending on the medication. These drugs are all generally well tolerated and have acceptable side effects that are manageable but do require treatment by a health care provider trained in their administration and adherence to a rigorous dosage schedule.

Bisphosphonates are the largest class containing several medications, including alendronate (Fosamax™) released in 1995 and risedronate (Actonel™) released in 2000, and are medications that slow the loss of bone mass (catabolic). They are often the initial, front-line medications to treat osteoporosis by health care providers. The two pathways of administration are by mouth (orally) and intravenous infusion.

Bisphosphonates

The oral route:

- **Increases bone density 3%-5% per year.**
- Must be taken on an empty stomach every day for 3-5 years.
- Drug side effects include gastrointestinal upset, reflux disease (GERD), and rarely tooth loosening (1/30,000) or femur fracture (3-10/100,000) with very long-term use.

Intravenous infusion:

- **Increases bone density 5%-10% per year.**
- Is a convenient once-a-year treatment, for 3-5 years.
- First time users (40%) may have a flu-like reaction with the first infusion, but the rate of osteonecrosis-induced teeth loosening and femur fracture rate are less (1/100,000).

Raloxifene (Evista™) was released for use in 1997 and is a selective estrogen receptor modulator (SERM) that can treat postmenopausal women with osteoporosis to decrease the risk of fractures and reduce the risk of invasive breast cancer. In postmenopausal women with osteoporosis, bone resorption outpaces bone production leading to a loss of bone mass due to the decline in estrogen. This medication ameliorates this process, thereby preserving bone density.

Raloxifene

- **Increases bone density 2.5% per year.**
- Is administered orally daily (60mg) for 3 years.
- The most serious side effect is deep venous thrombosis (DVT, 1/100 patients) along with hot flashes, flu-like symptoms, arthralgias, muscle spasm, blood clots, edema, and infection. Women on raloxifene should be monitored for blood clots regularly.
- The medication's use is limited to women and is less prescribed than the bisphosphonates.

Denosumab (Prolia™), released in 2010, is a synthetically produced antibody that specifically neutralizes the cells in bone that resorb and remodel it (inhibits osteoclast formation). Consequently, this allows for a net increase in bone density, preserving bone strength and integrity, while decreasing the chance of skeletal osteoporotic fractures.

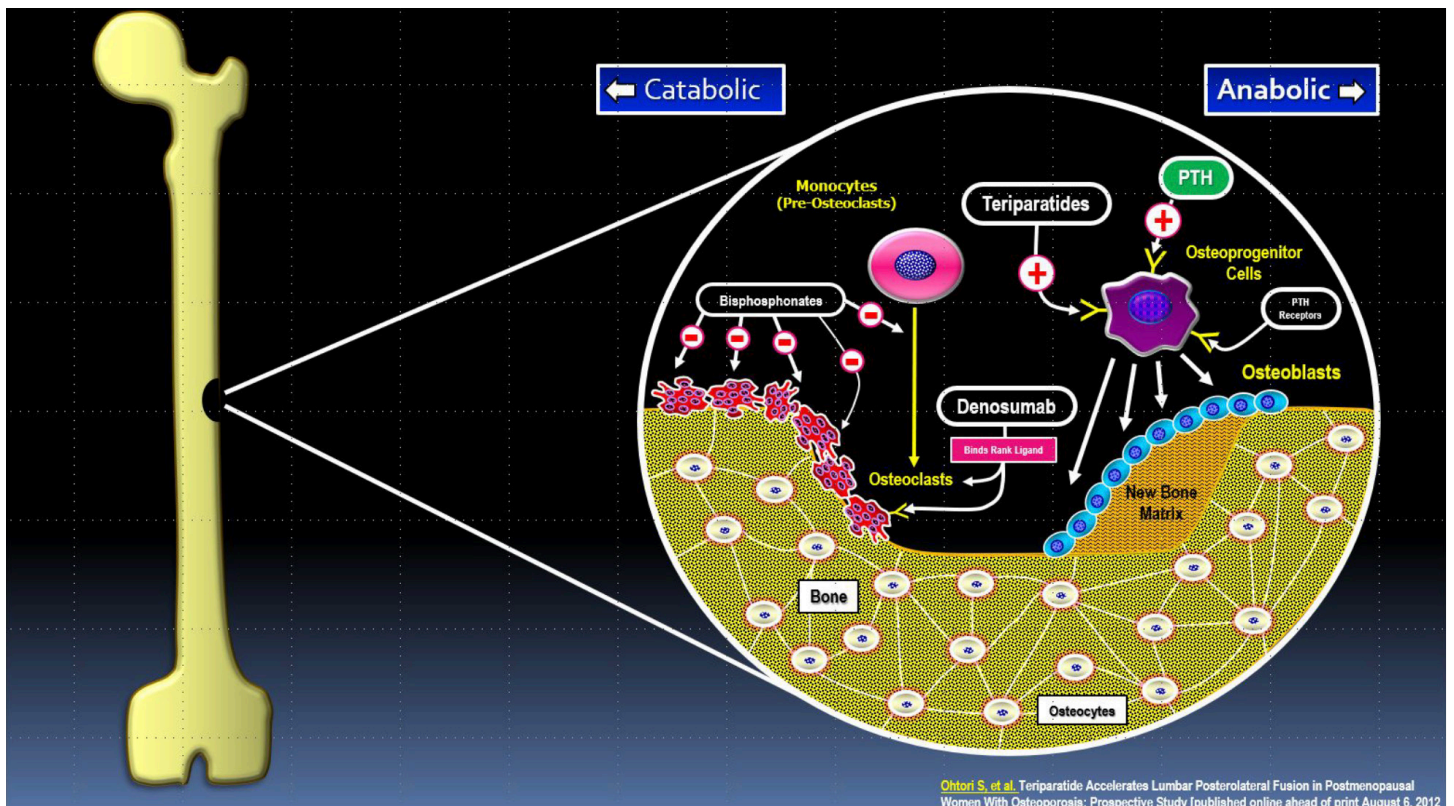
Denosumab

- **Increases bone density by 5%-10% per year.**
- Is administered by subcutaneous injection every 6 months.
- Possible side effects include back pain (35%), extremity pain (12%), osteonecrosis of the jaw, femur fractures (similar to bisphosphonates), and infections (5%) that occasionally result in hospitalization (0.7-0.9%).
- Is safe in people with kidney disease.
- Can be a lifelong treatment, unless the patient is transitioned to another osteoporotic medication (such as a bisphosphonate or teriparatide), to prevent a rebound osteoporotic vertebral fracture.

Parathyroid analogs provide potent treatment of severe osteoporosis, just as a person's natural parathyroid hormone (PTH) can improve bone density. PTH analogs include teriparatide (Forteo™) released in 2002 and abaloparatide (Tymlos™) released in 2017. These anabolic medications have been shown to dramatically increase bone density by stimulating bone formation.

Parathyroid Analogs

- **Increases bone density 10%-18% per year.**
- They are administered daily by subcutaneous route for up to a 2-year period once during the patient's lifetime.
- Common side effects include body aches/arthralgias (10%-20%), GI side effects (5%-10%), rhinitis (9%), dizziness due to orthostatic hypotension (10%), urinary stones, and hypercalcemia.
- Abaloparatide (Tymlos™) is safer in patients with kidney disease.
- Reduces the incidence of fractures by up to 80%.
- Is often used to improve bone density prior to surgery.



Romosozumab (Evenity™) was released in 2019 and is the newest medication to be developed for the treatment of severe osteoporosis and is another synthetically produced monoclonal antibody that neutralizes a specific bone pathway protein (Sclerostin). This novel approach to osteoporosis treatment allows for the body to produce more bone building cells (anabolic), resulting in a rapid increase in bone density.

Romosozumab

- **Increases bone density 15%-20% yearly.**
- Is currently approved only for postmenopausal women with osteoporosis.
- The medication is administered subcutaneously monthly for 12 months duration.
- Common side effects include arthralgia (8%-13%) and headaches (5%-6%),
- It is not recommended in patients with a history of stroke or a heart attack in the previous year.

- Follow-up treatment with another osteoporosis medication to prevent the rebound effect of bone loss and subsequent fracture is required.

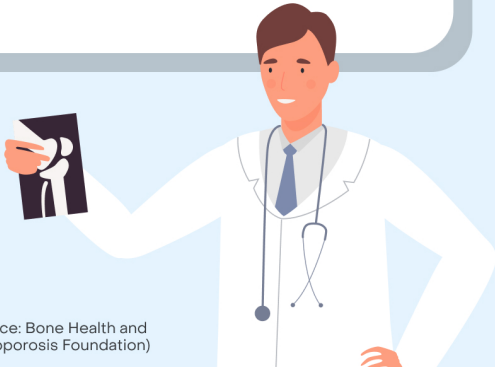
Osteoporosis is a serious medical problem that can be life threatening. Depending on the severity of the osteoporosis, these medications now offer patients effective treatment of the disease when combined with a directed bone health program and will stabilize or improve poor bone, potentially preventing catastrophic skeletal fractures.

Although there are few studies that directly compare the effectiveness of these drugs to one another, there are enough studies to support their use not only to prevent fractures but also to pre-treat patients that have planned orthopedic procedures to strengthen the bone and prevent frequently encountered severe complications. This is particularly important when preparing for spine surgery. The evidence is compelling enough

Summary Table of Medications for Osteoporosis

Medication	Route	Timing	Treatment Duration	Possible Side Effects
1st Tier Drugs (Mild to Moderate Osteoporosis)				
Bisphosphonates	Oral or IV infusion	Daily or yearly	3-5 Years	GERD, Jaw Necrosis
Raloxifene (SERM)	Oral	Daily	3 Years	Venous Thrombosis
2nd Tier Drugs (Moderate Osteoporosis)				
Denosumab	Subcutaneous Injection	Every 6 Months	Long Term	Back Pain Jaw Necrosis
3rd Tier Drugs (Severe Osteoporosis)				
Teriparatides	Subcutaneous Injection	Daily	2 Years of Lifetime	Nausea Bone Pain
Romosozumab	Subcutaneous Injection	Monthly	12 Months	Stroke Heart Attack

54 Million Americans
Have Low Bone Density
or Osteoporosis



(Source: Bone Health and Osteoporosis Foundation)



These medications now offer patients effective treatment of the disease when combined with a directed bone health program.”

that the **College of Neurological Surgeons (CNS) 2021 Guidelines** found that the following predict an increased risk of osteoporosis-related adverse events after spine surgery:

- preoperative dual-energy X-ray absorptiometry scan (DXA) with T-score < -2.5
- computed tomography scan with Hounsfield units < 97.9
- serum Vitamin D3 level <20 ng/mL

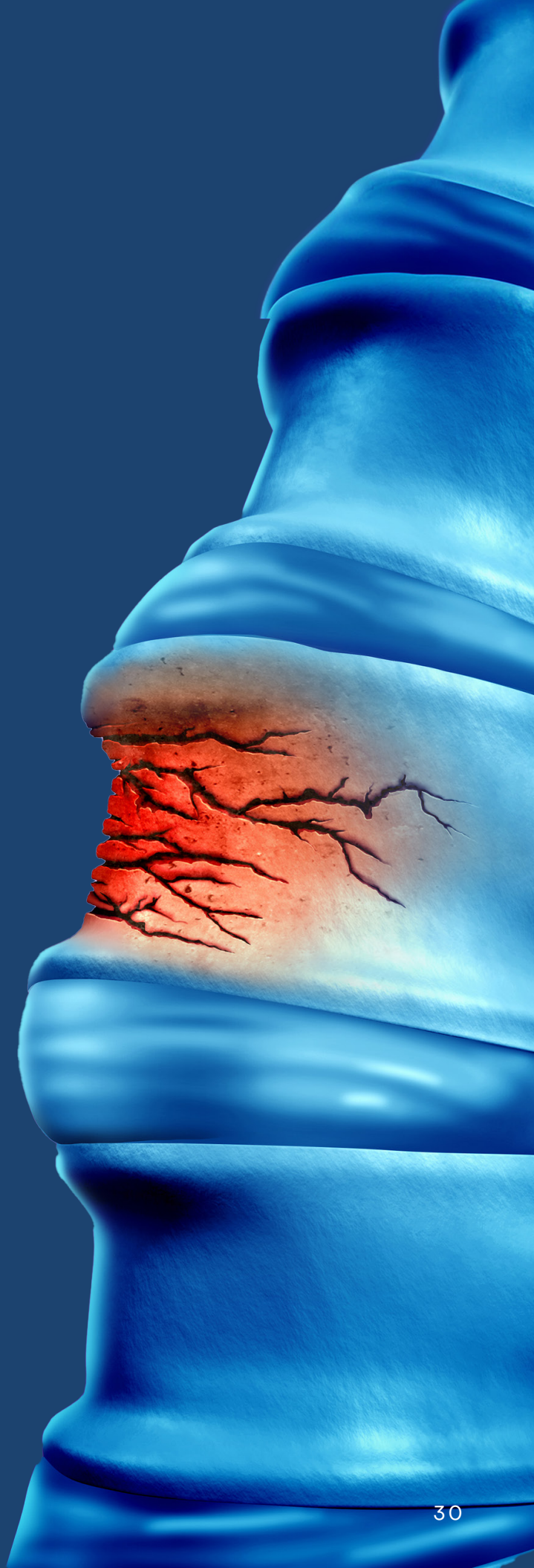
The task force also concluded that preoperative osteoporosis treatment with teriparatide increases bone density, induces earlier and more robust fusion, and may improve select patient outcomes. Spine care specialists not only recommend identification and robust treatment of all patients with osteoporosis but are also strongly recommending those undergoing elective surgery be pretreated.

Perhaps the most important recommendation our experts can make is that individuals be their own advocates and ask their health care providers to evaluate them for osteoporosis and initiate an effective therapeutic treatment plan. Those with documented osteoporosis undergoing elective spine surgery should also request that their surgeon arrange for pre-treatment with medications since the guidelines found earlier and more robust fusions and potentially improved outcomes in patients undergoing treatment for osteoporosis.

In summary, there are many medications these days to treat osteoporosis, which is initially a silent disease of the bone and that is often underdiagnosed and untreated. Find out your bone status by requesting a bone evaluation with your health care provider today!

Section 5

31. *Managing Osteoporotic Compression Fractures*



Managing Osteoporotic Compression Fractures

*Ganesh M. Shankar, MD, PhD
Massachusetts General Hospital*



Background

Osteoporotic vertebral body compression fractures (VCFs), or vertebral insufficiency fractures, occur when the density of the bone is insufficient to maintain its structural integrity in the setting of trauma or even minor events. VCFs most commonly occur in the lower half of the thoracic spine or upper half of the lumbar spine. They are accompanied by pain along the spine that occurs with activity or postural changes, roughly at the location of the fracture. These types of fractures are not commonly associated with symptoms of leg pain or weakness. Surprisingly, many fractures are “silent” because patients do not have any symptoms from them.

Risk Factors

One major risk factor for a VCF is low bone density, which is measured with a bone density scan. Other important risk factors are prolonged use of steroid medications, any history of prior fracture, or certain medical conditions such as hyperparathyroidism and chronic renal failure. They are frequently seen among post-menopausal females as the balance in maintaining skeletal mineralization is shifted away from deposition of new bone to increased bone turnover with the loss of estrogen. Approximately 20% of patients with a prior VCF will sustain another vertebral fracture over the following 12 months.

Evaluation

VCFs are evaluated with imaging studies to delineate the location of the fracture, the anatomy of the fracture, and impact on the spinal alignment (tendency to bend over). The impact of the fracture on spinal alignment is visualized by standing spine X-rays – either a focused image of the involved segment (thoracic or lumbar) or the entire spine (scoliosis view). These imaging studies will also provide more confidence that the VCF is a result of low bone density rather than an underlying pathology, such as a tumor. An MRI can help determine the age of the fracture and presence of pinching of the spinal cord or nerves which helps to plan the best course of treatment.

Management

When an osteoporotic VCF is diagnosed, there are two considerations for management – (1) addressing the symptoms and (2) reducing the risk of future insufficiency fractures.

Treating Symptoms

The acute symptoms are often managed well with **acetaminophen** and **anti-inflammatory medications** such as ibuprofen or naproxen, available over the counter. If the pain is severe, then a short course of **opioid analgesics** may be



required. **Calcitonin** is a hormone normally secreted by the thyroid that reduces serum calcium by inhibiting cells that break down bone (osteoclasts). A recombinant form of calcitonin isolated from salmon can be administered subcutaneously or intranasally and has been demonstrated to reduce pain for the first 2-4 weeks following a VCF.

Intermittent use of a **brace** can also help reduce pain in the acute and subacute stages, but chronic long-term use can lead to atrophy of the paraspinal muscles from disuse. Similarly, to prevent deconditioning of these core muscles following a VCF, return to activity as tolerated and engagement in **physical therapy**, including consideration for **aqua therapy**, is encouraged.

Vertebral augmentation is where cement is injected into the broken vertebra to provide stability and rapid pain relief. This treatment is an excellent option for patients with an acute or subacute (<6 months) VCF who have ongoing discomfort that is refractory to analgesic therapy and activity modification. Two

techniques are available. **Vertebroplasty** involves the injection of cement (polymethylmethacrylate) into the fractured vertebral body under X-ray control. **Kyphoplasty** has the additional use of a balloon to expand a cavity within the fracture with the goal of restoring vertebral body height and permitting a larger volume of cement.

These procedures are performed with sedation or general anesthesia. Vertebral augmentation has the highest likelihood of therapeutic benefit in patients with severe pain that is refractory to oral analgesics. The pain relief achieved in this timeframe can often facilitate engagement with core strengthening exercises and mobilization.

In patients with chronic pain from VCF, with discomfort lasting longer than 6-12 months, there should be consideration for repeat imaging by X-ray, CT, and MRI. The structural etiologies that can result in persistent pain include **(1)** VCF at a new level, **(2)** progressive kyphosis (hunchback) at the level of the fracture, and **(3)** compression



of the neural elements at the level of the fracture. Depending on the findings of these updated imaging studies, patients with persistent pain can be considered for vertebral augmentation (if new acute/subacute fractures are identified), physical therapy (core strengthening), pain management for consideration of facet ablations, and possible surgical evaluation (if compression of the neural elements is suspected to be contributing to the ongoing discomfort). Surgical treatment is rarely warranted as poor bone quality is associated with many complications.

Reducing Future Fractures

To reduce the risk of future insufficiency VCFs, the underlying bone density will need to be addressed metabolically. The mechanism of these pharmacologic interventions is based on altering the physiology of bone maintenance – which is a constant balance of breaking down old bone and forming new bone. The use of medications is discussed in detail in the previous article.

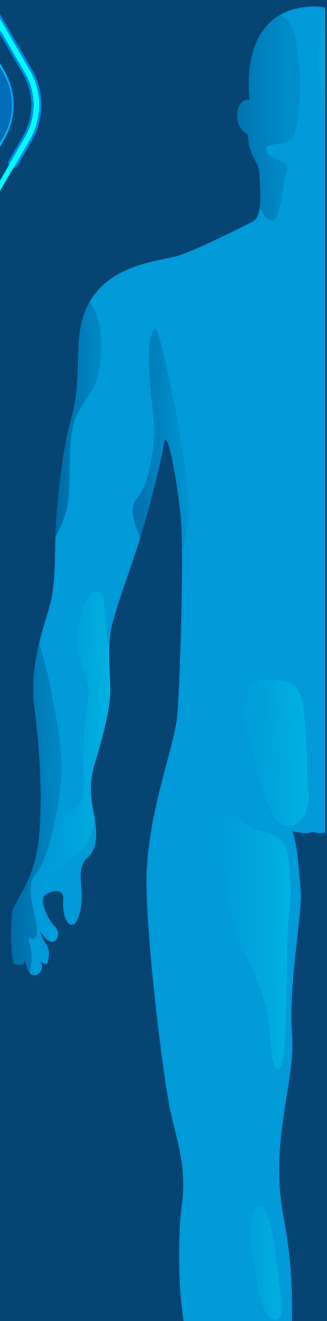
Medications to treat osteoporosis are very effective: bone density can increase up to 15% in one year and future fractures are reduced by 60%-75%. Patients older than 65 years with a fragility spinal fracture are candidates for medication treatment to prevent the next fracture. In addition, early treatment may lead to more rapid pain resolution.

Conclusion

In summary, the pillars of VCF treatment are in diagnostic imaging and pain management (oral analgesics, physical therapy, and vertebral augmentation). Treatment of underlying bone metabolic disorders will also need to be considered in this patient population. The vast majority of patients presenting with a VCF can be managed non-operatively with the central goal of restoring function and mobility.

Section 6

35. Bone Health and Spine Surgery





Bone Health and Spine Surgery

Paul A. Anderson, MD
University of Wisconsin



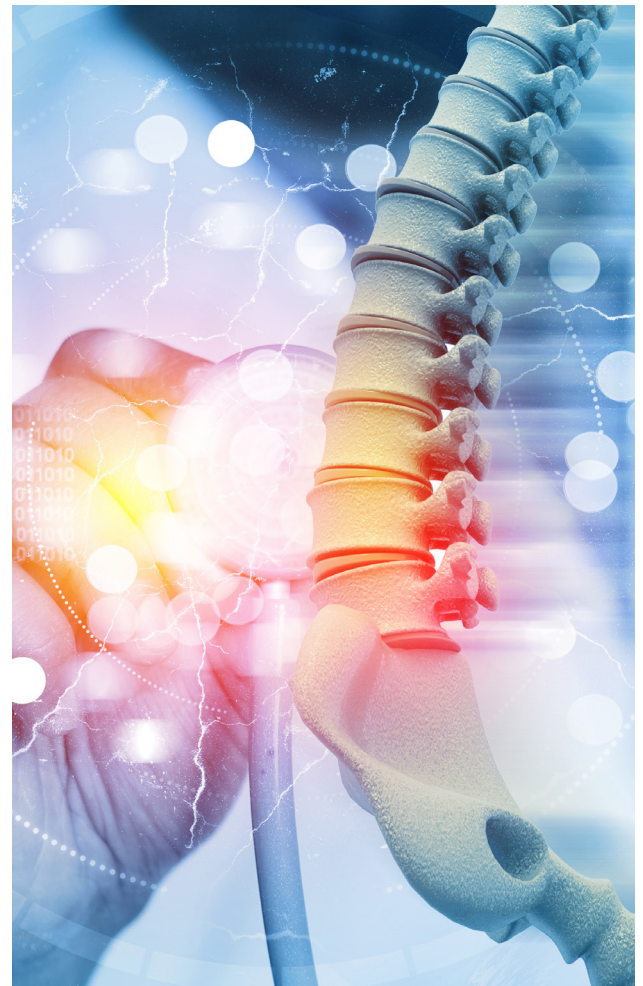
Approximately 25%-30% of patients over the age of 50 years undergoing spine surgery have osteoporosis.”

Introduction

Osteoporosis is a common condition associated with decreased bone mineral density and other structural changes in bone that reduce bone strength, which increase the chance of a fracture. Approximately 25%-30% of patients over the age of 50 years undergoing spine surgery have osteoporosis. Osteoporosis can be diagnosed based on DXA testing, fracture history, or when high fracture risk is present. DXA is commonly used to measure bone mineral density and when results (reported as a T-score) are less than -2.5, osteoporosis is present. Patients who sustain hip or spine fractures after the age of 50 years are also considered osteoporotic. In addition, osteoporosis is present if your fracture risk is high. One online tool to measure this risk is the FRAX 10-year risk calculator. Identifying, assessing, and optimizing risk factors to be better prepared for spine surgery will be explored in this article.

Bone Health & Elective Surgery

Bone health is very important to the results of spine surgery. Spine surgery typically removes some bone structure, potentially weakening the bone, which can lead to complications and need for further surgery. In addition, many cases involve the use of screws and cages that may loosen when the bone quality is poor. If fusion is



performed, then a complex healing process occurs that may not be as robust when osteoporosis is present. Vitamin D helps build strong bones, even in adults, and is deficient in the majority of spine surgery patients. To emphasize the importance of bone health, one study from the Mayo clinic showed that 50% of patients with osteoporosis undergoing spinal fusion surgery developed bone-related complications, including screw loosening, vertebral fracture, failure of bone healing and need for revision surgery. The good news is that medical treatment can improve bone quality, and treatment has been shown to improve outcomes and reduce complications. How do you know if you need treatment?

Know Your Risk Factors

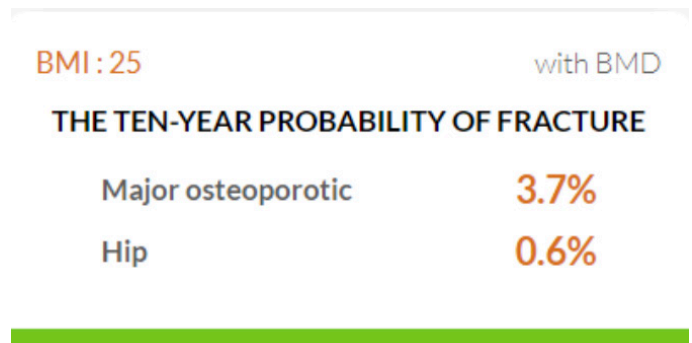
Risk factors can help identify the presence of poor bone health and the need for treatment. The most common risks include older age, female gender, exposure to bone harming medications and other toxins, sedentary lifestyle, fracture history, parental family history of hip fracture, certain comorbidities such as diabetes, hyperparathyroidism, chronic kidney disease, inflammatory arthritis and low bone mass as measured on DXA. See **Table 1**. If you have been diagnosed with osteoporosis or have been treated for osteoporosis with medication, then you are at risk for complications after spine surgery.

Assessing Fracture Risk

A method used to calculate your risk and the need for medication is the Fracture Risk Assessment Tool or FRAX. This determines your risk for a hip fracture and a major osteoporotic fracture. The FRAX calculator is free to anyone and can be found by searching the web for “FRAX” or going to <https://frax.shef.ac.uk/frax/index.aspx> for the traditional version or www.FRAXplus.org to experience the updated version. You will complete a short questionnaire that includes your region of the world and country, the presence or absence of 11 common risk factors, and your DXA results if available (otherwise leave blank). The output (see FRAX example) of the FRAX is the 10-year risk of a major osteoporotic and hip fracture. You are

Table 1

Risk factors for osteoporosis and associated complications from spine surgery	
Patient factors	
Older age (>65 years)	
Female	
Use of bone harming drugs such as steroids and anticonvulsants	
Lifestyle	
Use of tobacco/nicotine products	
Excessive alcohol intake (>2 drinks/day)	
Sedentary lifestyle	
History	
Prior diagnosis or treatment of osteoporosis	
History of falls in last 6 months	
Diseases such as hyperparathyroidism, diabetes, rheumatoid arthritis	
Chronic kidney disease	
Fracture history	
History of fracture since age 50	
Parent with history of hip fracture	



FRAX example

considered at high risk if your FRAX shows a hip fracture risk > 3% and major osteoporotic fracture risk > 20%; these are the thresholds to consider medical treatment.

Classify Your Bone Health

Bone disease is classified as low risk, high risk, and very high risk. It is important that adult men and women understand where they are currently at on this spectrum and monitor changes over time.

Low risk patients have:

- No history of recent fractures
- T-score > -2.5 on DXA
- Low probability of fracture on FRAX

High risk patients have:

- A history of a hip or spine fracture since age 50 years
- T-score < -2.5 on DXA
- 10-year probability of osteoporotic fracture > 20% on FRAX

Very high risk patients have:

- A recent hip/spine fracture
- Multiple fractures
- Fractures while under treatment for osteoporosis
- Very low T-score < -3.0 on DXA
- High probability of fracture risk > 30% on FRAX

Pre-Surgical Bone Health Optimization

In some instances, optimizing bone health should be performed before and after surgery. Patients who are at high risk meet criteria for medical treatment of osteoporosis. See **Table 2** for a list of indications to treat osteoporosis when considering spine surgery.

Medical treatment for all patients should include 2000-5000 IU of daily Vitamin D3 and 1000-1200 mg of calcium in the diet or with supplements. If you meet criteria, prescription medication treatment can be initiated by the surgeon's office or by a bone health specialist. The preferred medication

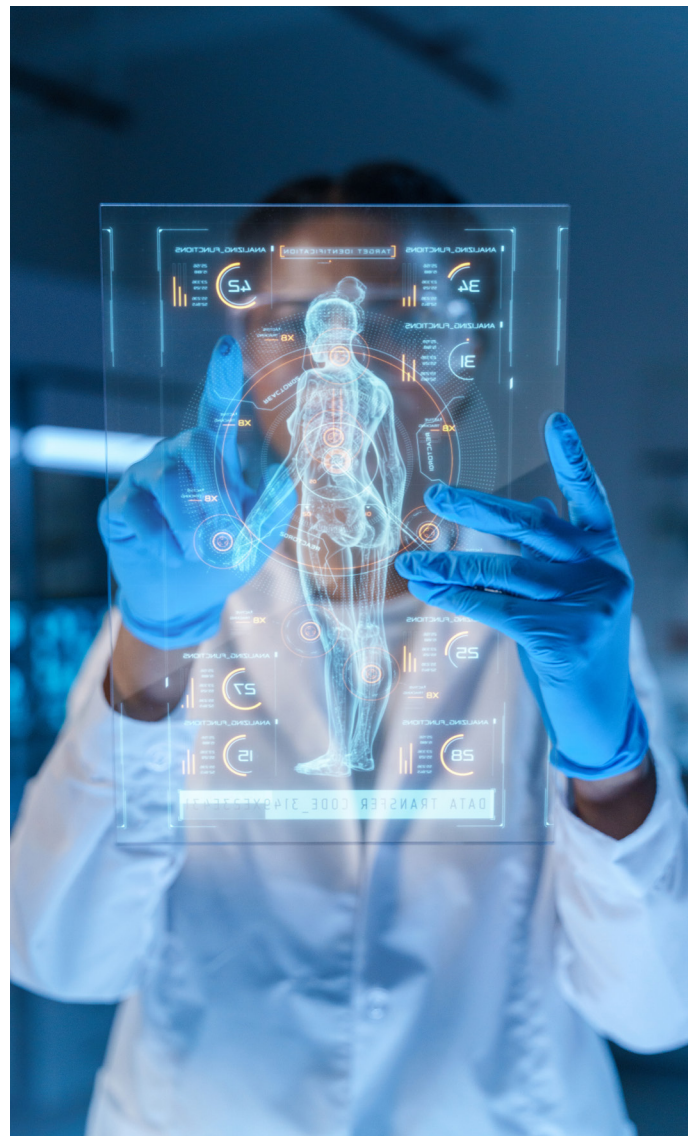


Table 2

Indications for bone health optimization of osteoporosis when considering spine surgery
A low DXA test score: T-score lower than -2.5
History of hip/ spine fracture since age 50 years
High 10-year fracture risk on FRAX: Hip fracture > 3% Major osteoporotic fracture > 20%
Other indications: Revision surgery after bone-related complications Surgeon reports likelihood of poor bone



would be an injectable bone forming drug. These medications rapidly increase bone density, bone strength and new bone formation within 2-3 months. Not all insurers will cover these medications and there are other effective medications that can be used.

A surgical delay to build your bone may be indicated if possible. The delay is usually 3 months but can be longer in cases where osteoporosis is severe or the surgery is very complex. This should be discussed with the surgeon and bone health team. If a delay is not possible, then medical treatment can occur after surgery.

Conclusion

Poor bone health is more common than you may think. You should consider your bone health prior to spinal surgery, as weak or brittle bone leads to complications and further surgery. Your fracture risk should be calculated and you should ask if a DXA test to measure your bone density is indicated. If you are at high or very high risk, then medical management should be considered.

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Mayo clinic showed that 50% of patients with osteoporosis undergoing spinal fusion surgery developed bone-related complications”



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From the Research Institute

- 40. Maximizing Peak Bone Mass: An Adolescent's Blueprint for Skeletal Health*
- 43. A College Student's Perspective on Bone Health*
- 45. The Time is Now: The Importance of Bone Health for Women in Their Twenties*



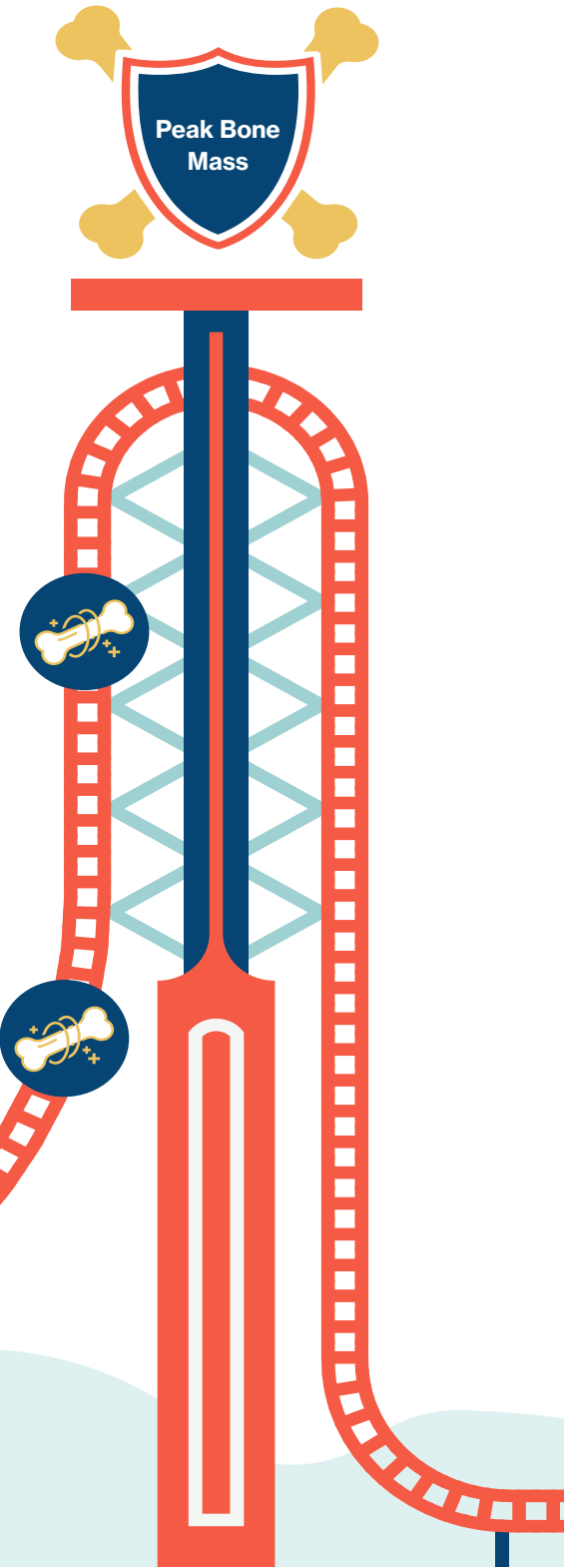
Maximizing Peak Bone Mass: An Adolescent's Blueprint for Skeletal Health

Justin Pokrant, The Research Institute

Picture this: You're on a bone-building roller coaster climbing toward its peak. The higher you go, the stronger your bones will be, and the more you can do to maximize this period of bone development, the better the ride down will be.

Believe it or not, this roller coaster mirrors the reality of bone growth, and if you are an adolescent, I have good news and bad news. The **good news** is that you are actively ascending the roller coaster, building bone mass at a record-breaking speed. The **bad news** is that you are approaching the peak and you are in for a rocky ride down if you don't make the most of this bone-building period. While adolescence is about building bone mass, adulthood is about maintaining bone mass. What you've stored up in your bone bank by around age 30 is what you've got to bank on for the rest of your life.¹

Two types of cells play a pivotal role in bone development: **osteoblasts** and **osteoclasts**. Osteoblasts build new bone tissue, whereas osteoclasts digest damaged bone tissue.² Even before we are born, both types of cells are heavily at work, but osteoblasts function at a faster rate when we are young. This explains why some teenagers seem to grow half a foot overnight!



You might be wondering how this relates to the roller coaster. If you haven't already pieced it together, the period where the coaster climbs toward its peak symbolizes adolescence – the window of time when osteoblasts are incredibly active. As reported by The Bone Health & Osteoporosis Foundation, kids develop 90% of their lifetime bone mass by 18 years of age.³ Therefore, it is crucial that high schoolers fully understand how to set themselves up for a long, strong life.

Well, what does that entail? I'm glad you asked! In the hustle and bustle of high school, bone health might not seem like the most enthralling endeavor, but it doesn't have to be a chore! Here are some bone-boosting, fun-filled ways for high schoolers to weave a touch of excitement into their daily routines while building up their bone bank!

Bone Builders

Riding the bone-building roller coaster requires a well-rounded diet, rich in many vitamins and minerals. One cornerstone of the skeletal system is **calcium**, which is found in dairy products such as yogurt, cheese, and fortified plant-based alternatives. Think of calcium as the cross beams that reinforce the bone-building roller coaster; without it, osteoblasts would fail to function and the entire coaster would collapse. The Office of

“

What you've stored up in your bone bank by around age 30 is what you've got to bank on for the rest of your life.”

Dietary Supplements at the National Institutes of Health recommends that adolescents 9-18 years old consume 1,300mg of calcium per day, which is the largest recommended dose for any age demographic, further spotlighting the significance of taking action during adolescence.⁴

Similarly, **magnesium** contributes to the roller coaster's foundation by aiding in calcium absorption, and **Vitamin K** acts as the roller coaster's engineer ensuring that our bones are structurally sound during development. Magnesium is concentrated in nuts, seeds, and whole grains, and Vitamin K is abundant in leafy greens like kale and spinach.

Believe it or not, spending time in the sun aids bone growth by allowing your body to absorb **Vitamin D**. How is that helpful? Well, our bodies can not absorb calcium without Vitamin D, which we already know is a key player in the skeletal system. Vitamin D also has ties to immune response and inflammation reduction.⁵ So, take advantage of sunny days by organizing outdoor activities that double as Vitamin D sources. Plan picnics, bike rides, basketball games, and anything else that will get you outside. It's a win-win-win – a chance to soak up the sun, create memorable moments with friends, and engage in fun-filled activities that keep bones strong and spirits high. In the winter months or during periods of reduced sun exposure, Vitamin D can be obtained through the diet by drinking fortified milk or orange juice and by eating eggs (the yolk is a great source of Vitamin D) and fish.

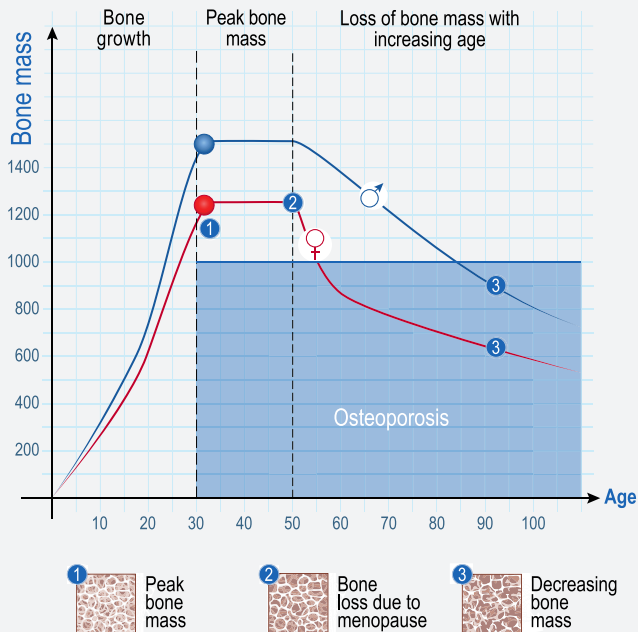
The bone-building roller coaster is made to move, and so are you! Embracing an active lifestyle will accelerate bone growth and amplify bone strength. So, go **get active**: hit the hiking trails, shoot some hoops, go for a walk with friends, and break it down on the dance floor. Whatever it is, do something that makes you smile while stimulating your osteoblasts.

¹Healthy Bones Matter. NIH. Published August 2023. Accessed December 23, 2023. <https://www.niams.nih.gov/health-topics/kids/healthy-bones>

²Osteoblasts and Osteoclasts. The Cleveland Clinic. Published March 27, 2023. Accessed December 23, 2023. <https://my.clevelandclinic.org/health/body/24871-osteoblasts-and-osteoclasts>

³Optimizing Peak Bone Mass in Children. BHOFF. Published October 4, 2020. Accessed January 2, 2024. <https://americanbonehealth.org/young-athletes/optimizing-peak-bone-mass-in-children/>

Bone mass and Age



Bone Reducers

Steer clear of **excess sugar** – the bone density-disrupting loose screws of the roller coaster – that often hides in over processed snacks and sugary drinks. After all, it only takes a few loose screws to cause the entire roller coaster to malfunction! There are many reasons why adolescents should avoid caffeine intake, but adding to the list is that caffeine decreases bone formation by blocking the normal activity of osteoblasts and osteoclasts.⁶ **Caffeine** is found in many sodas and energy drinks, which have become popular among adolescents.

A **sedentary lifestyle** is like the rust that eats away at your roller coaster's support system. To maintain structural integrity, it is important to minimize prolonged periods of sitting and slouching, ensuring your bones remain engaged and ready for growth at all times.

Conclusion

An adolescent's ride on the bone-building roller coaster requires proactive measures to maximize peak bone mass. By eating a nutrient-dense diet, embracing an active lifestyle, and taking advantage of time in the sun, adolescents can safeguard a smooth roller coaster ride through life. Remember, the clock is ticking, and the bone density you craft now isn't just a chapter, it's the spine of your life's story.

⁴Calcium: Fact Sheet for Health Professionals. NIH. Published October 6, 2022. Accessed January 2, 2024. <https://ods.od.nih.gov/fact-sheets/Calcium-HealthProfessional/><https://spinehealth.org/article/lifelong-nutrition-for-healthy-bones/>

⁵Mayo Clinic Staff. Vitamin D. Mayo Clinic. Published August 10, 2023. Accessed December 23, 2023. <https://www.mayoclinic.org/drugs-supplements-vitamin-d/art-20363792#:~:text=Vitamin%20D%20is%20a%20nutrient,cellular%20functions%20in%20your%20body.>

⁶Berman, N.K., Honig, S., Cronstein, B.N. et al. The effects of caffeine on bone mineral density and fracture risk. *Osteoporos Int* 33, 1235–1241 (2022). <https://doi.org/10.1007/s00198-021-05972-w>



A College Student's Perspective on Bone Health

Brandon Allen, BA, The Research Institute

College is a unique environment that provides an experience like no other. From academics to social life, there are many things to keep a student occupied. As a result, it is easy to deprioritize your health. Bone health is an important aspect of general health that most college students do not even know about, which this article aims to change. The most critical time for bone growth is before the age of 30, and if we don't work on it now, low bone mineral density causes significant issues later on in life. There is a lot of research in bone health, and I am going to simplify it for you.

Bones are a dynamic living tissue that work similarly to a bank account where you make deposits and withdrawals throughout your life. With a savings account, the idea is that you save money while you are young so that when you are older, you have the liberty to enjoy retirement and live off of those savings. It is the same idea with your bone health.

The body has two sets of cells that contribute to the building and breakdown of bone, called **osteoblasts** and **osteoclasts**. When you are young, your body spends much more time building bone than it does breaking down old bone. This results in a net gain of bone and contributes to your bone density or bone savings "fund." By the time you reach 30 years, your body is no longer able to continue making significant deposits to your bone mass and the process transitions to more of a maintenance program. Later in life, the process will transition to a net loss of bone where you will be withdrawing bone density faster than maintaining it.

Similar to your savings account, if you did not contribute enough to this "fund" early on, you will be limited later on in life. These limitations are far worse than not being able to take a vacation to Europe, but rather that you may develop osteoporosis which can lead to fractures as a direct consequence of

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The secret to achieving peak bone mass and an ideal bone savings "fund" is to have this knowledge before it is too late.”





The Time is Now: The Importance of Bone Health for Women in their Twenties

Kirsten Schuler, BS, The Research Institute

Bone health is a crucial aspect of overall well-being, and establishing good bone habits in your twenties is the best way to lay the strongest foundation for a healthy skeletal system throughout your life. During this period, females typically reach peak bone mass, making it a critical time to focus on practices that promote optimal bone density and strength. In this article, we'll explore the importance of bone health in your twenties and provide practical tips to ensure you're taking advantage of this time in your life.

Women in their twenties are able to enjoy the pinnacle of their youth and vitality. However, amidst

the chaos of busy lives and burgeoning careers, it's easy to overlook a fundamental aspect of well-being - bone health. Often unknown by most young adults, maintaining strong and healthy bones during this pivotal decade is crucial for preventing future health issues.

The twenties mark a critical period for bone development as women reach their peak bone mass. **Peak bone mass** is the highest amount of bone tissue an individual can attain, and it is typically achieved by the late twenties. Building strong bones during this phase provides a foundation for maintaining optimal bone health



throughout life. Failure to attain sufficient peak bone mass can increase the risk of osteoporosis and fractures in later years.¹

The twenties are characterized by significant hormonal fluctuations, especially during puberty and early adulthood. **Estrogen**, a key hormone in bone health, plays a crucial role in regulating bone density. Adequate levels of estrogen are essential for the absorption of calcium and other minerals necessary for bone strength.² Women in their twenties must prioritize proper nutrition and engage in activities such as weight-bearing exercises to support hormonal balance and promote bone health.

Osteoporosis, a condition characterized by weak and brittle bones, is a significant concern for women as they age, particularly after **menopause** (losing estrogen tremendously impacts bone health). Establishing healthy bone density in the twenties acts as a powerful preventative measure against osteoporosis later in life. Adequate calcium intake, Vitamin D absorption, and regular weight-bearing

exercises are key components in maintaining bone density and reducing the risk of osteoporosis.³

The twenties often bring about lifestyle changes, including dietary habits and physical activity levels. Adopting a bone-friendly lifestyle during this decade can have long-lasting effects. Consuming a balanced diet rich in **calcium, Vitamin D**, and other essential nutrients is vital for bone health. Additionally, engaging in **weight-bearing exercises**, such as jogging, dancing, or weight training, helps build and strengthen bones. Popular classes such as yoga, pilates and core strength training have risen in popularity recently, and are all great for increasing fitness while building bone strength.

Women in their twenties and beyond are surrounded by **unhealthy habits** such as excessive alcohol consumption, smoking/vaping, or extreme dieting. These behaviors can have detrimental effects on bone health. Excessive alcohol interferes with calcium absorption, smoking/vaping reduces estrogen levels and blocks the ability to build bone, and extreme dieting may lead to nutrient deficiencies

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Establishing healthy bone density in the twenties acts as a powerful preventative measure against osteoporosis later in life.”





necessary for bone strengthening.³ Minimizing or eliminating these habits is essential for preserving bone health. If you are going to partake in a glass of wine or another adult beverage, remember to enjoy these spirits in moderation to protect your health.

Maintaining strong bones in the twenties is not only crucial for overall health but also for **reproductive well-being**. A healthy skeletal system provides optimal support during pregnancy and helps prevent complications such as gestational diabetes and preeclampsia. Furthermore, it aids in the postpartum recovery process.⁴

Investing in bone health during the twenties is an investment in a healthier and more vibrant future. By prioritizing nutrition, exercise, and positive lifestyle choices, women can lay the groundwork for strong bones that will serve them well throughout their lives. These lifestyle choices will not only protect your bones, but will also positively impact your mental and physical well-being. Acknowledging the importance of bone health in the twenties empowers women to take proactive steps in caring for their bodies, ensuring a foundation of strength and resilience for the years to come.

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Often unknown by most young adults, maintaining strong and healthy bones during this pivotal decade is crucial for preventing future health issues.”

¹Lewis RD, Modlesky CM. Nutrition, Physical Activity, and Bone Health in Women

²Seifert-Klauss V, Prior JC. Progesterone and Bone: Actions Promoting Bone Health in Women. *Journal of Osteoporosis*

³Weaver C. Nutrition and bone health. *Oral Diseases*.

⁴Clarke BL, Khosla S. Female reproductive system and bone. *Archives of Biochemistry and Biophysics*.

About Our Authors

About Our Authors



Dr. Paul A. Anderson is a board-certified orthopaedic spine surgeon with special interest in spine trauma, tumors, cervical spine, and geriatric spinal diseases and osteoporosis. He is an internationally recognized expert in the field of orthopaedic spinal surgery and currently holds an academic position as Emeritus Professor of Orthopedic at the University of Wisconsin. He has served as President of the Cervical Spine Research Society and President of the Lumbar Spine Research Society and has held various positions in a number of spinal and orthopaedic societies. He has served as a member as well as Chairman of the AAOS Biomedical Engineering Committee, Co-Chair of ASTM 04.25, and Clinical Chair of ASTM F04.

Most recently, he chaired the “Own the Bone” Steering Committee of the American Orthopaedic Association which aims to educate medical practitioners and patients on the importance of bone health and promote fracture liaison services. In 2022 he received the 3rd Annual Lifetime Achievement Award from the Cervical Spine Research Society. He currently serves as a Reviewer for Osteoporosis International and a member of the Scientific Advisory Council of ISCD as well as Vice President of ISCD. Dr. Anderson earned his undergraduate and Master’s degrees from The University of Michigan in Chemical Engineering. He completed medical school and orthopaedic residency at Wayne State University and a clinical spine fellowship with Dr. Henry H. Bohlman (Case Western Reserve University, Cleveland).



Dr. John R. Dimar II received his medical degree from Wright State University School of Medicine in Dayton, Ohio. His residency training in orthopedics was completed through the Lutheran Hospital Orthopedic Residency Program in Fort Wayne, Indiana, followed by a six-month chief resident internship with the Leatherman Spine Center. Dr. Dimar then served in the United States Air Force at the Regional Hospital in Minot, North Dakota, serving as Chief of Surgery and Assistant Chief of Hospital Services. He then returned to Louisville to complete a spine fellowship with the Leatherman Spine Center for one year and continued as faculty.

Dr. Dimar is a Professor with the Department of Orthopedic Surgery and Chief Pediatric Orthopedics at University of Louisville School of Medicine. He is active in instructing residents, spine fellows and orthopedic surgeons in the treatment of deformities, tumors, degenerative disease and trauma involving the spine. He is a faculty of the Leatherman Spine Center and has trained over 100 spine fellows who practice across the world. His particular area of interest is the treatment of pediatric deformity, spinal tumors, complex cervical spine disease, degenerative spine disease and spine trauma. Dr. Dimar is actively involved with research. He has published numerous articles and book chapters on the treatment of spinal problems and has spoken widely at many national and international spine meetings. He is a member of the AAOS, SRS, NASS, and ISASS.



Dr. Brandon B. Carlson is a spine surgeon who specializes in comprehensive spine care. As an academic spine surgeon, he treats patients with degenerative conditions, spinal deformity, scoliosis, cervical spine disorders, traumatic injuries, tumors, infections, and revision spinal surgery. Dr. Carlson completed his undergraduate degree at University of Kansas in Lawrence KS, a Master of Public Health at University of Kansas - School of Medicine, and medical school training at University of Kansas - School of Medicine.

After medical school, he completed an orthopedic surgery residency at University of Kansas - School of Medicine and a fellowship in Complex Spine and Scoliosis surgery at Hospital for Special Surgery in New York, NY before starting as a staff surgeon at University of Kansas Health System. He has a special interest in minimally invasive spine surgery. He was integral in the process of acquiring advanced robotic technology at the University of Kansas Health System for spinal surgery. He is one of the leading surgeons utilizing robotic-assisted surgery to perform minimally invasive procedures and offer patients faster recovery, less pain, and optimal outcomes. He also has a passion for spinal deformity procedures including scoliosis in both adults and pediatric patients.



Dr. Venu Nemani is a spine surgeon specializing in cervical spine and spinal deformity surgery at Virginia Mason Franciscan Health in Seattle, WA. Dr. Nemani completed his PhD in neuroscience and medical school at the University of California, San Francisco, residency at Hospital for Special Surgery in New York, and spinal fellowship training in (1) Tokyo Japan for scoliosis and cervical spine surgery, (2) Washington University School of Medicine in St. Louis for complex adult and pediatric spinal deformity surgery, and (3) Columbia University in New York for complex adult and pediatric spinal deformity surgery. Dr. Nemani's practice focuses on the surgical treatment of all disorders of the cervical spine and he has particular expertise in the surgical treatment of complex disorders of the thoracic and lumbar spine including scoliosis, kyphosis, flatback, and revision spine surgery.

Dr. Nemani has authored more than 50 peer-reviewed research articles in many of the top journals in spine surgery and neuroscience, including Spine, The Spine Journal, Neurosurgery, Neuron, Journal of Bone and Joint Surgery, and the Journal of Neuroscience. He has presented over 70 scientific studies at national and international conferences, and written more than 15 book chapters on various topics in spine surgery. Dr. Nemani continues to be actively involved in research to improve the outcomes and safety of spine surgery, and is an active member of AO Spine, the Cervical Spine Research Society, and the Scoliosis Research Society. He has also volunteered his time as a spine surgeon in Ghana, where he surgically treated some of the most rare and complex spinal deformities in both pediatric and adult patients.



Dr. Zeeshan M. Sardar is an Associate Professor and the Associate Chief of Spinal Deformities at Columbia University, Department of Orthopedics, and the Medical Director of the Spine Unit at The Ochsner Spine Hospital/Allen. His practice is devoted exclusively to the treatment of pediatric and adult spinal disorders. His practice focuses on the operative care of spinal deformities and degenerative conditions. After receiving his bachelor's degree in electrical engineering, master's in computer science, and doctorate in medicine from McGill University in Canada, Dr. Sardar went on to complete his residency in orthopedic surgery at the McGill University Health Centre where he served as the chief resident. Following residency, Dr. Sardar completed a fellowship in Orthopedic and Neurological Spine Surgery at the Cedars Sinai Medical Center in Los Angeles, followed by a spine surgery fellowship focusing on Artificial Disc Replacement and Spinal Deformity at the Texas Back Institute, and a subsequent fellowship in Advanced Spinal Deformity at Columbia University and the Ochsner Spine Hospital at New York-Presbyterian.

As an active member of the academic orthopedic and spine communities, Dr. Sardar is a member of the American Academy of Orthopaedic Surgeons, AO Spine, the North American Spine Society, the Scoliosis Research Society, and the International Society for the Advancement of Spine Surgery. He serves on the Scoliosis Research Society's committee for Spinal Deformity, the North American Spine Society's committee for Spinal Deformity, AO Spine Deformity Knowledge Forum, as well as the American Academy of Orthopaedic Surgeons' Adult Spine Evaluation Committee. He has been appointed Co-Chair of the Data Operations Committee for the American Spine Registry. Dr. Sardar engages in research to advance the diagnosis and treatment of complex spine conditions. His research interests are focused on patient optimization prior to surgery and on improving clinical and surgical techniques to improve patient safety and ensure better surgical outcomes.



Dr. Ganesh Shankar is a board-certified spinal neurosurgeon at Massachusetts General Hospital in Boston. He completed his PhD at Harvard University Graduate School of Arts and Sciences, graduated from Harvard Medical School, completed his neurosurgery residency at Massachusetts General Hospital, and spine surgery fellowship at Cleveland Clinic. His clinical specialization encompasses the evaluation and surgical management of all spine pathologies, ranging from degenerative disorders, primary and metastatic spine tumors, intradural pathologies, spine infections, and spine trauma. His surgical approaches include minimally invasive techniques. He specializes in complex spine procedures requiring revision surgery and correction of spine deformities.

In addition to treating patients with spinal disorders, Dr. Shankar runs an active research effort on the mechanobiology of spine disease. Dr. Shankar performs research on bone biology and molecular determinants of primary and metastatic spine neoplasms. He serves as the Neurosurgical Director of Biospecimen Banking for the Department of Neurosurgery. His research has been recognized by awards from the American Association of Neurological Surgeons, Congress of Neurological Surgeons, Joint Section on Disorders of the Spine and Peripheral Nerves, and AO Spine North America.

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A Message on Philanthropic Giving



The National Spine Health Foundation is able to celebrate broad impact in the lives of patients around the world because of the generosity of our philanthropic supporters. As the only nonprofit organization fully devoted to our mission of helping patients overcome spinal conditions and get back to their lives, we rely on supporters like you to help fund our patient-centered educational resources, groundbreaking research, and tireless advocacy.

In order to reach more patients each year through cutting-edge information, accessible resources, and life-changing community, we need your support.

Giving back to the National Spine Health Foundation means giving back hope and a bright future for countless patients in need. Join us as a leader in spine health by making a gift today. Together, we can create a future where patients no longer suffer from debilitating spinal conditions.

Interested in learning more about how you can support our mission? Please contact Sheila Santiago at SSantiago@spinehealth.org or Rita Roy at rroy@spinehealth.org.

Scan the QR code to make a contribution or visit www.spinehealth.org to learn more.



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The NSHF advocates for patients and therefore requires robust support to continue its important work. Philanthropy for NSHF is an important initiative that I support because I want to empower the voices of our patients and make spine care the best it can be for future generations.”

– Dr. Rajiv Sethi, Chairman, Medical and Scientific Board

“

Everyone’s efforts help to create a ripple effect through the spine health community. Contributions support the researchers who tirelessly work to discover ways to improve spinal health, provide hope to affected patients and support the caretakers who stand by their loved one. I am proud to understand this reach and incredibly humble to be able to be involved with such a wonderful organization.”

– Jamie Harvey, Board Member



Watch our latest talks on Bone Health and the Spine on spinehealth.org



Practical Guidance for Bone Health and Your Spine

Featuring Thomas C. Schuler, MD, FACS | John Dimar, MD | Brandon Carlson, MD, MPH | Rita Roy, MS, MD

This easy to follow discussion helps people understand the condition of osteoporosis, which is a weakening of the bones, and why this matters to your spine health. In addition, the experts delve into how to prevent osteoporosis, how to treat it if you have it, and why bone health is such an important component of spine health, and your overall health.

Learn more at www.spinehealth.org or scan the QR code below.



Osteoporosis & Your Spine, An Overview

Featuring Thomas C. Schuler, MD, FACS | Venu Nemani, MD, PhD | Rita Roy, MS, MD

When it comes to spine health, taking care of the 33 bones (the vertebrae) that make up your spine are very important. Keeping these bones healthy and strong keeps your spine in motion. If you need to have spine surgery, the bones need to be strong enough to sustain the correction that surgery is attempting to make. And if your vertebrae are weak, they can fracture creating a complicated recovery picture. Osteoporosis is the condition of weakened bones, and knowledge about it should not be limited to the elderly; prevention starts early in life. Staying in motion keeps you alive, so preventing fractures and keeping the bones strong are critical to your life. We dive into these topics in this comprehensive overview of bone health, osteoporosis and your spine.

Learn more at www.spinehealth.org or scan the QR code below.



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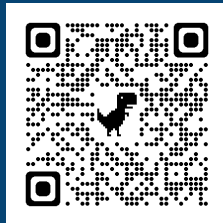
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