

## Chapter 8 - Protect Your Bones: How To Keep Them Strong

Your bones combine to form your skeleton serving as the scaffolding of your body and as protective shields for your internal organs. The strong outer structure composed of calcium and other minerals is interlaced with tiny blood vessels and nerves. The inner, more liquid portion is rich in blood vessels and provides the manufacturing site for your red blood cells. After you reached your full height, the lengthening of your bones slowed but for the rest of your life they dynamically change *in thickness*.

Once your adult height has been reached, a lifelong renovation process continuously remodels your bones. Biologists see these bone “remodeling units” at work all throughout the skeleton. <sup>(r91-r350-r265-r514)</sup> Thousands of tiny manufacturing sites are removing and reforming the skeleton as materials are recycled and new bone tissue is deposited. The massive construction project is directed by your hormones using the materials you have supplied in your diet. Around 35 to 40, as progesterone levels begin to decline, your bone removal tends to outstrip your formation, and your bones will slowly begin to decrease in density. If your body cannot maintain enough new bone formation, your bones will continue to lose density and become increasingly fragile. Eventually that fragility results in osteoporosis. What’s a woman to do? Learn about the magic of bone structure and function. And you will see how you can keep your bones strong, your whole life long.

### **Bank on Your Bones**

Much like a bank in which you can deposit money to cover future expenditures, bones serve as a bank for calcium. Although genetic limitations exist, your lifetime dietary practices exert major influences on how robust your principal stays. The more calcium and Vitamin D that you can deposit before age 35, the greater your peak bone mass. As early as 1941, Dr. Albright and his colleagues observed that osteoporosis rarely develops before menopause. <sup>(r14)</sup> They suggested it was a disease related to the

decline of reproductive hormones. And they were correct. If you haven't had a hysterectomy, your perimenopausal transition beginning around in your early 40s sets in motion a change in hormonal patterns that initiate the "withdrawal" of these calcium savings, typically about 1% to 2% per year. If you're an African American woman, you will likely have much more bone mass than if you're a white American. African American women in one relatively recent study had quadruple the average testosterone level and double the average estrogen level as their white counterparts before menopause <sup>(r600)</sup>.

### **Hysterectomy and Bone**

It's hardly surprising that hysterectomy would be bad for bones. Surgical menopause triggers a *dramatic loss of bone*. Unchecked, a hysterectomized woman can lose more than 60% of the bone she had as a young woman. In 1988, evidence was published to show that hysterectomy (even when the ovaries were retained) accelerated the loss of bone compared to intact women of similar age <sup>(r176)</sup>. Until she takes aggressive action with a combination of nutritional, hormonal and exercise regimens, a post-hysterectomy woman is at extreme risk of osteoporosis. After a hysterectomy, protecting her bones should be near the top of a woman's health agenda.

In the U.S., 40% of white women at age 50 can expect to suffer a bone fracture as they grow older <sup>(r89)</sup>. Without preventive action, most women by age 80 will have only 40% of the total body bone mass they had at age 40. Unfortunately, the diagnosis of osteoporosis is generally made only after the fractures reveal that profound losses of bone have already occurred. Your risk factors for a bone fracture are old age, a previous fracture, maternal history of fracture of the hip, a low bone mineral density, and a low quantitative bone ultrasound measure. Start fighting osteoporosis before a fracture.

### **Bone Tests: Keep it simple**

Your bone strength depends on how much microdamage exists; the collagen and matrix quality; the geometry of the bone (its shape, its tendency to bend or break under pressure); and its mass – or bone mineral density <sup>(r265-r386)</sup>.

There are inexpensive and very useful measures to determine whether you need more extensive and more expensive bone testing. One of my discoveries in 1986 was that your spinal bone density could be efficiently and inexpensively tested by measuring your wrists with “single photon absorptiometry” if you were correctly categorized as “intact” or “posthysterectomized”.<sup>(r176)</sup> Also measures of bone in the heel are easy, have very low radiation using either single photon absorptiometry (SPA) or ultrasound, and take about 2 minutes to do. If you have access to such a test, take it. If your bone in your heel (calcaneus) or wrist shows evidence of good density, the likelihood is that so will your hip and so will your spine. The risk of hip fracture among more than 9700 post-menopausal women was predicted by the bone mineral density in the heel or the forearm.<sup>(r164-r54)</sup> If these scores show deficient bone, then a DEXA test, using a Dual Energy X-Ray Absorptiometry, may be prescribed. But go for the easy tests first.

### **Defining Osteoporosis**

Osteoporosis was originally defined by the World Health Organization in 1994 as *a disease that was characterized by low bone mass and micro-architectural deterioration of bone tissue, the combination of which would lead to an increased risk of fractures*<sup>(r199)</sup>. A score, the t-score, of -2.5 or lower was considered quantitatively representative of osteoporosis.

#### **Box 8-1**

##### **The T-Score**

If you never had or don't remember your elementary statistics course in college, picture 100 women standing in a line evenly distributed from the shortest on the left to the tallest on the right. A -2.5 t-score (in height) would place you right between the second and third shortest. Likewise, bone density can be measured by an X-ray type machine, and a score provided and scaled. The -2.5 t-score on bone mineral density would put your score between the second and third lowest bone mineral density score of 100 young, healthy women. Pretty bad!

In 2000, osteoporosis was redefined by the National Institutes of Health (NIH) as *a skeletal disorder characterized by compromised bone strength predisposing to an increased risk of fracture.*

The National Osteoporosis Risk Assessment Study enrolled 200,000 post-menopausal women in their early 60's and found a clear correlation between bone mineral density and number of fractures within the next year. But not all women with fractures had low bone mineral density and not all women with low bone mineral density had fractures. Hip fractures tend to occur after age 75 and are difficult to predict based on spinal measures that cannot take into account the woman's behavioral habits, slippery stairs, and so forth. For both younger and older women spinal fractures are much more common and can be predicted and often prevented.

### **Fear of Fractures**

These are not minor issues. The future risk of fracture for a 50 year old white person in the United States is greater than 40% in women, although only 13% in men<sup>(r89)</sup>. By age 80, more than half of women show deformities of the spine consistent with fracture<sup>(r683)</sup>. Vertebral fractures are 2 to 3 times more prevalent than hip fractures and can be extremely painful, debilitating, and produce postural deformities as shown in Figure 8-1 (see pg YY). But any fracture is serious: Half of those who fracture a hip will have permanent long-term disability; 25% will require long term nursing home care. And additional complications after fracture include pressure ulcers, pneumonia (from low oxygen capacity deriving from lack of mobility), urinary tract infections, and depression. Not a pretty prognosis and well worth preventing.

### **Fear of Falling**

Falls are the precipitating trigger for 90% of the hip fractures, 50% of the vertebral fractures, and 99% of the wrist fractures.

If it's hard for you to rise from a chair without using your hands and if your gait is poor, you've got the 2 significant traits associated with falls. So are sedative hypnotics or having impaired neuromuscular and visual function.

For those who face such risks, the household environment should be reconfigured to reduce "booby traps" that can be tripped on. Loose area rugs, uneven

floors or shallow steps, inadequate lighting, debris on the floor, and pet accessories all cause falls.

Among older women, falling appears even more likely in those with Vitamin D deficiency. Vitamin D deficiency is rarely obvious because it requires a blood test that many labs are not able to perform accurately. By 2005, scholars at the National Osteoporosis Foundation were in consensus that Vitamin D<sub>3</sub> supplementation at a minimum of 800 IU per day is strongly recommended. By 2007, the data show clearly that 800 IU per day is not enough.

### **What's a Woman To DO to Protect Her Bones?**

Fortunately, there are actions you can take:

- 1) Appropriate and regular physical exercise.
- 2) Hold yourself erect with dignity (i.e. good posture).
- 3) Eat intelligently - nutritionally rich foods that provide the essential nutrients your bones require.
- 4) Avoid unhealthful habits – like smoking,<sup>(r404)</sup> excessive drinking, couch potato sitting, and eating junk food.
- 5) Take nutritional supplements like calcium and Vitamin D<sub>3</sub> right after eating (to enhance absorption) when you are not getting enough through your food and exposure to sunlight.

Such a disciplined approach will reward you with basic joie de vivre and good bones. The great thing about the actions we take to prevent disease is how good they feel while we do them and how great they feel once we make them part of our daily routine.

### **How Exercise Affects Bones**

Exercise appropriately and you are less likely to trip and fall because your “balancing muscles” will be in strong condition.<sup>(r556)</sup> Try this: Lift one leg to stand on one foot without holding onto a wall. Now shift to the other foot. If you can do it eyes open for 30 seconds, that's good.

### Very Vigorous Training is Effective

Several experiments have studied the effects of physical performance exercises on bone density in post-menopausal women. *The verdict is unanimous: your bones benefit when your muscles are exercised.*

For example, one experiment studied 260 postmenopausal women, 40 to 65 years old, for 12 months. All were given calcium supplements (800 mg/day). The 260 women were divided into 4 groups and measured to note changes in bone density.

1 Did not exercise and took no hormone therapy (HT).

Results: No increase in bone density.

2 Did not exercise but did take HT.

Results: Increase in bone density.

3 Regular, vigorous exercise but took no HT.

Results: Increase in bone density (similar 2).

4 Did regular vigorous exercise and took HT.

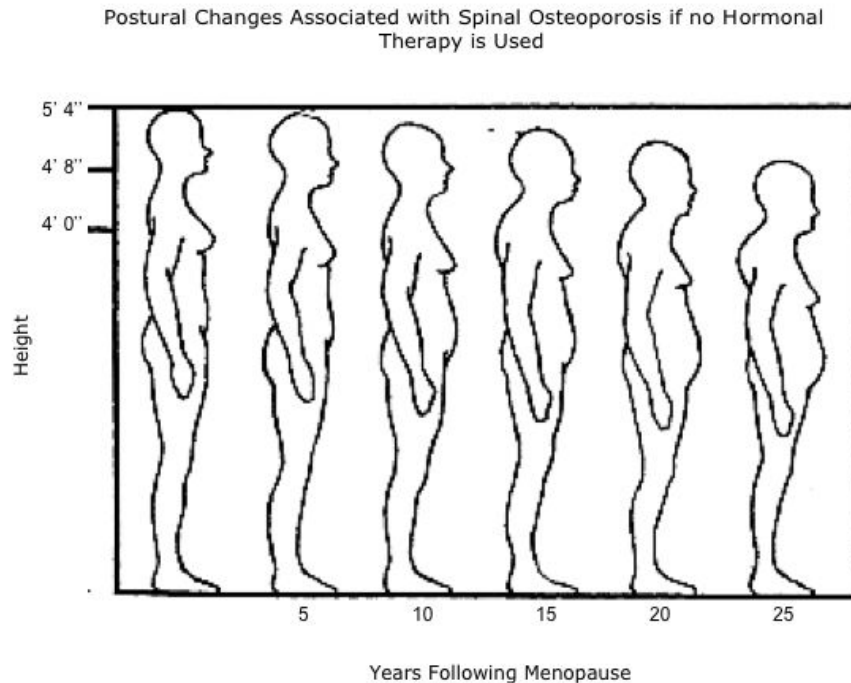
Results: Increase in bone density like 2 and 3.

The vigorous exercise, let's be clear, was no walk in the park. The rigorous regimen included: weight lifting, stretching, and additional resistance exercises for balance and flexibility <sup>(r271)</sup>. The women worked out at an intensity that was 60% of their maximal heart rate - hard enough to be working, but not excessively stressful. They also engaged in regular stair climbing, which began with 120 steps and increased progressively to 300 steps while they wore 10 to 28 lb weighted vests. (Imagine carrying a couple of bags of groceries up 300 steps and you'll get the idea.)

The researchers were trying to compare benefits to bone density brought about by HRT with and without exercise. Women who took placebo and did no exercise did not show any increase in bone mineral density. **But either exercise or hormonal therapy worked about the same.**

What you should know: Get—and keep—moving: Bone mineral density improved if the woman took hormones or if she exercised vigorously. But if she took placebo and did not exercise, bone density did not improve. For your bones, not to mention the rest of your health, choose an exercise program you will stick to.

**Figure 8-1: Postural Change Associated with Osteoporosis without HRT**



### How posture helps bones

Regular exercise for maintaining balance and muscle tone will prevent falls <sup>(r623-r455)</sup> and help to promote an erect, graceful, and dignified posture. Kyphosis (the hunchback posture) typically becomes noticeable in the early 60s of an intact woman and reflects the characteristically low estrogen and progesterone years after menopause. One study my colleagues and I did, surprisingly showed that 35% of healthy women executives were already kyphotic in their late 30s <sup>(r172)</sup>.

This Figure (8-1) shows the kyphotic posture leading to the hunchback characteristic of the loss of muscle tone combined with the crushing of thinning bones, as osteoporosis progresses within the spine of aging women.

I believe it is possible to prevent kyphosis. Not everyone becomes kyphotic. If you are able to keep the muscles of your back and mid-frame taut and tight through regular exercises, and if you stand and sit erect, your own muscles will hold your spine erect. *Good posture takes practice* and will start to “feel” right compared to slouching. As the twig is bent, so grows the limb.

The next Figure (8-2) shows the skeletal regions that are under the greatest stress because they are positioned at the natural curves of the spine. If the bones are thinning, and supporting muscles are too weak, these regions experience the greatest gravitational pressure. This is why erect posture is so powerful; it reduces the pull of gravity on these “pressure” points. If you use a particular chair most often, try hanging a mirror where you can routinely observe your posture. You’ll find yourself “sitting up.” See how good posture looks better. And it will feel better as you practice.

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### **How Sunlight Boosts Bones**

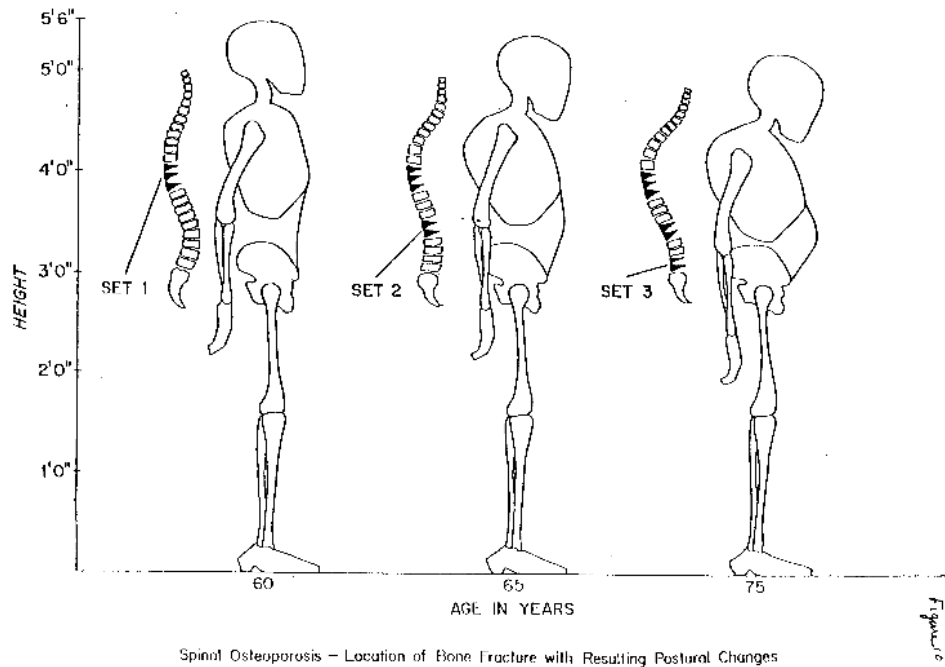
Bones are internal; how could sunlight have any impact on them? As you’ll see in this chapter, sunlight is the trigger that sets in motion a great many physiologic processes that maintain and enhance life. The more that scientists investigate the role of sunlight, the more they appreciate how critical and life-giving the force of the sun is. When skin is exposed to the sun’s ultraviolet radiation, the skin produces a form of vitamin D. By the year 2007, cellular receptors for Vitamin D had been found just about everywhere scientists had looked: in the skin, in the gonads, in the brain, in the vagina, in the pancreas, in the stomach, and the heart muscles. This vitamin has already been shown to prevent or reduce the risk of osteoporosis as well as opposing breast and prostate cancer, hypertension, and cardiovascular disease.

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### **Figure 8-2: Spinal Osteoporosis –Location Of Bone Fracture With Resulting Postural Changes**

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### Bones in the buff

Benjamin Franklin, in his autobiography first written in 1729, described his understanding of the importance of sunlight when he described his daily habit of sitting naked in a window to allow sun on his skin every day for at least 15 minutes. <sup>(r247)</sup> Apparently, he found a private location to do so. It is stunning to consider that in the middle of the 18<sup>th</sup> century, Franklin's genius extended from discoveries of geophysical forces of electricity, to developing public libraries, to forming a great university, to major contributions to the fledgling U.S. democracy, and to the need for sunlight on his own skin. Fifteen minutes a day, in a time of year when the sun can access your skin through ultraviolet B radiation, probably is just about right. You may be able to "try this at home" with judicious care.

### **Vitamin D Absorption: Skin Shades Matter**

The paler your skin, the greater its capacity to respond to sun and convert its cholesterol precursor product into the Vitamin D\* for so many of our body functions like calcium absorption and cancer prevention. The darker your skin, the higher its content of melanin, a substance that absorbs the UVB and thereby blocks the beneficial action of UVB that generates pre-Vitamin D. So the darker your skin, the more exposure to sunlight it needs to do its job – forming pre-Vitamin D. Even the elderly with their reduced levels of previtamin D<sub>3</sub> still have a large capacity to make adequate Vitamin D if they get enough sunlight!

### **The dark side of sun blocks**

A sunscreen with a sun protection factor of 15 applied to sun-exposed skin absorbs more than 99% of the ultraviolet B radiation. Unfortunately, using a sunscreen blocks the very site where sunlight is converted into the Vitamin D. If you have tanned skin, that also blocks the sun's capacity to deliver vitamins. So I'm not advising to get a tan, just get some sunlight on your bare skin. Like Ben.^

### **Vitamin D: How Much is Healthy?**

The medical evidence surrounding Vitamin D is recent. In 1941, the recommended dietary allowance (RDA) for Vitamin D was set at 400 IU. <sup>(r841)</sup> This was the amount recognized as essential (i.e. one-teaspoon of cod liver oil) to prevent the bone deformity disease known as rickets. Since then, a large body of research revealed that rickets was not the only disease that can occur if a person does not have enough Vitamin D.

Vitamin D insufficiency can be lead to osteoporosis, muscle pain and fatigue, hypertension, cardiovascular disease, and other physiological debilities that then lead to cancer of the breast, colon, and prostate, diabetes, multiple sclerosis, and lupus <sup>(r355-r331)</sup>. Serious problems you don't want to face.

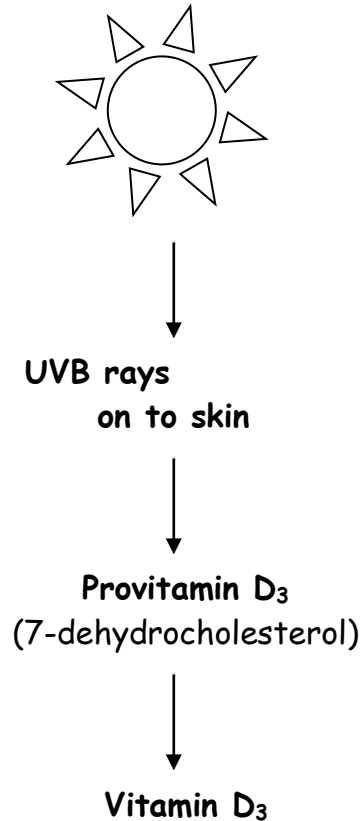
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\* Vitamin D terminology is confusing in the literature and inconsistently defined in dictionaries. For the purposes of this book, refer to Figure 8-3 (Ideagram of Sunlight and Vitamin D).

^ See Chapter 12 re dermatology concerns

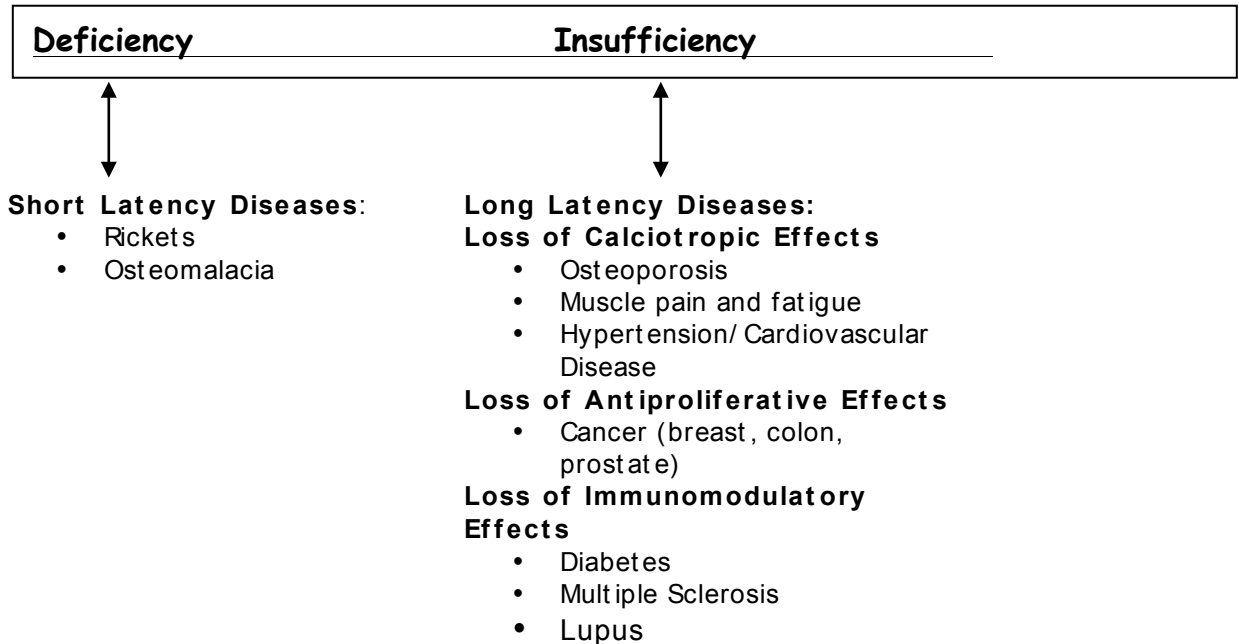
For example, more than 25% of breast cancer deaths in European women can be attributed to a lack of exposure to ultraviolet B from sunlight <sup>(r355-r290-r291)</sup>.

**Figure 8-3 Sunshine Ideagram for Vitamin D**



What you should know: You probably need more vitamin D. As the discoveries were published, it became increasingly clear that we need much higher levels of circulating D than were previously considered appropriate (even as recently as 2005). Now, evidence shows that women over the age of 70, or those with not enough reproductive hormones, need either regular sunlight on exposed skin or to ingest at least 1000 IU per day of a supplement. For people who suffer with fragile bones or poor health, most expert scholars in the field of Vitamin D research recommend much higher levels. <sup>(r328)</sup>

Figure 8-4: Vitamin D: Short and Long Latency Diseases



From Whiting SJ & Calvo MS (2005)<sup>(r841)</sup> Dietary recommendations for Vitamin D: a critical need for functional endpoints to establish an estimated average requirement. *J Nutr* 135: 304-9. (Figure 3)

### Measuring Vitamin D in Blood

Only in the last few years have researchers had the scientific capacity to reliably measure blood levels of the circulating Vitamin D and then only in highly specialized research laboratories <sup>(r326)</sup>.

### Can you eat enough vitamin D?

There are a few food sources that naturally contain high doses of the form of Vitamin D that our bodies need. Very few! These include cod liver oil, sardines, and salmon. Unfortunately, the Vitamin D supplement currently added to milk is trivially low <sup>(r355)</sup>.

### Which Supplement is Effective?

By 2004, researchers had evidence from enough scientific studies to show that Vitamin D<sub>2</sub>, the supplement most commonly sold then, was ineffective. **Vitamin D<sub>3</sub>, cholecalciferol, was the effective form** <sup>(r25)</sup>. In 2004 it was difficult to find

Vitamin D<sub>3</sub>. Now, you should be able to find, or inquire about, D<sub>3</sub> (cholecalciferol) supplements in health food stores.

### **Vitamin D Serves Multiple Roles**

The Vitamin D table below outlines the importance of Vitamin D.

Table 8-1: <sup>(r841)</sup>

So How Much Vitamin D<sub>3</sub> is Enough? The amount of Vitamin D<sub>3</sub> you need to achieve or maintain a given blood level of Vitamin D concentration is not yet known. But investigations have approximated the answer.<sup>(r841)</sup> Dr. Robert Heaney works in Omaha and conducted research studies there during the winter months of 2 successive years. Using the experimental data that they obtained, the authors concluded that for a 70 year old person the recommended levels of 600 IU per day are far too low and would produce a serum level of Vitamin D that is inadequate for bone maintenance and calcium absorption.<sup>(r331)</sup> Studies show that less than 700 IU per day failed to show the kind of exciting and very beneficial results shown in studies of higher levels, daily 800, 1000, or more IU per day. <sup>(r77-r803-r785-r78-r132-r191)</sup>

### How much is too much?

The upper limit for Vitamin D has not been set because each study seems to suggest that an even higher level than previously studied is likely to be more beneficial. So we can approach the question from the question of toxicity. At what level of ingestion of Vitamin D<sub>3</sub> is there danger? That result is pretty clear. You'd have to take continuing daily intakes of more than 10,000 IU per day (250 µg/d) to risk toxicity (r329).

#### **Box 8-2 Vitamin D Requirements for Bone Health: Research Examples**

**Study #1 Vitamin D reduces falls** About 90% of hip fractures involve falls. Fractures that are caused by falls occur in about 5% of elderly persons every year. Vitamin D has benefits on muscle strength as well as on the preservation of bone. Nutritional scientists tested whether 800 IU per day of Vitamin D<sub>3</sub> when added to a calcium supplement (1200 mg/ day) would reduce falls and improve bone health measures in elderly women. (r77) Elderly women, in long-stay geriatric care units in nursing homes, took the nutrients or they took placebo. Within a 3-month period, Vitamin D combined with calcium supplementation had reduced falls by 49% in frail, elderly women with Vitamin D deficiency at baseline.

**Study #2: Vitamin D improves lower body fitness** Following up on that theme, Dr. Bischoff and her colleagues next studied a representative sample of non-institutionalized United States women by testing what the baseline circulating blood levels of serum Vitamin D were and how these levels compared to lower extremity function; that is, the ability to walk 8 feet rapidly or rise and sit down from a chair 5 times in a row rapidly. The results were quite clear. Those with better walking ability and faster sit-to-stand speeds showed significantly higher levels of circulating serum Vitamin D in their blood. (r78)

**Study #3: Vitamin D lowers the rate of fractures** Other ways of examining relationships produced similar conclusions about the benefits of Vitamin D. (r803-r78). At the Cambridge School of Clinical Medicine in the UK, men and women who participated swallowed 1 capsule of Vitamin D<sub>3</sub>, 100,000 IU (per capsule), or a placebo every 4 months (3 capsules per year or 300,000 IU per year) After 4 years of the regimen (12 capsules), lab tests were done to confirm compliance by measuring serum Vitamin D in the blood. The results showed that the group taking Vitamin D did much better than the group taking placebo. They had a 33% lower rate of fracture in the hip, wrist, or forearm. Even better outcomes might have occurred if the Vitamin D levels achieved in the blood had been higher because the Vitamin D group had plasma levels only 40% higher than the placebo group (r785).

### **Study Conclusions Explained**

Not every study finds these positive results. However, a close examination of the studies that fail to find a benefit of Vitamin D also show that the participants had poor compliance; that is, a large majority did not take the vitamin as prescribed <sup>(r609-r637)</sup>. That means it never had a real chance to work or fail. Current statistical methods require “intention-to-treat” analysis, which includes all participants despite the fact that some did not follow the regimen. In other words, non-compliant persons who didn’t take the vitamin are included in the treated group <sup>(r665)</sup>. Some researchers believe this methodology generates distorted conclusions. <sup>(r489)</sup> I agree with these objections to treating NON-participants as if they were participants. They are “ghosts” rather than volunteers who made it to the finish line. Scientific reports where intention-to-treat research methods are used should be viewed with a discerning judgment. I believe one must look at how the questions were analyzed before drawing conclusions from them. That is what I have tried to do for you throughout the book.

### **Vitamin D: What’s a Smart Woman To Do?**

It seems prudent that every woman should take a Vitamin D<sub>3</sub> supplement of 1000 IU per day if she doesn’t do a “Ben Franklin” daily. Ideally, the supplement should be taken after, not before, a meal to enhance the absorption.

### **CALCIUM: IT DOES YOUR BODY GOOD**

Calcium is the “stuff” of bones but also serves many key roles throughout the body. It regulates nervous impulses, influences hormonal levels, and reduces hypertension. Every day, through sweat, urine and feces, the body disposes of more than 700 mgs of calcium, whether or not you consume any. That’s about the supply in a pint of skim milk or yogurt. These must be replaced or the mineral will be withdrawn from your bone bank.

[Back to the Bank: Deposits for Good Health](#)

Bones hold 99% of the calcium in your body. How much calcium is in your bones is regulated by 2 hormones produced in your parathyroid gland: parathyroid hormone (PTH) and calcitonin. When we ingest calcium, some of the nutrient gets absorbed from the intestine into the blood stream. And some of what is absorbed becomes “a deposit” into the bone bank. If you don’t get enough calcium, the PTH will signal bones for a “withdrawal” to supply it into the blood. If the deficiency continues long enough, you will experience some serious effects.

**Box 8-3 Age and PTH**

PTH (parathyroid hormone) tends to increase with age. PTH promotes resorption of bone by osteoclasts (bone-chewing cells), thus thinning your bones. Consuming calcium lowers this harmful age-related increase of PTH. <sup>(r132-r398-r511)</sup>

A high dose in an older woman begins at minimally 1200 mg per day of calcium. What does this mean?

High calcium in the diet is beneficial, if the serum level of Vitamin D is adequate. Calcium in high doses lowers the harmful age-related elevations of PTH that cause bone to become porous.

**Too Little Calcium: The Overall Risks**

A continuing low intake causes deficiency diseases by 3 separate mechanisms. <sup>(r326)</sup>

1. *Skeletal wasting* The skeleton has so much calcium that in extreme deficiency, it loses in a year only about 3% of its bone. After 10 years, insufficient calcium could lead to 30% of bone being wasted away.

2. *Kidney stones and colon cancer* Intestinal calcium absorption is very inefficient. Of the calcium we consume, less than 40% is absorbed into the bloodstream. The “inefficient absorption” appears to provide benefits that Dr. Heaney believes reduce the risk of both kidney stones and colon cancer. These unabsorbed calcium ions attach to unabsorbed food crystals or particles (“oxalates”), as well as fatty and bile acids. These calcium-bound crystals and bile acids are then excreted. If your kidneys are protected from this load of excess bile and fats, they are at less risk for developing kidney stones.



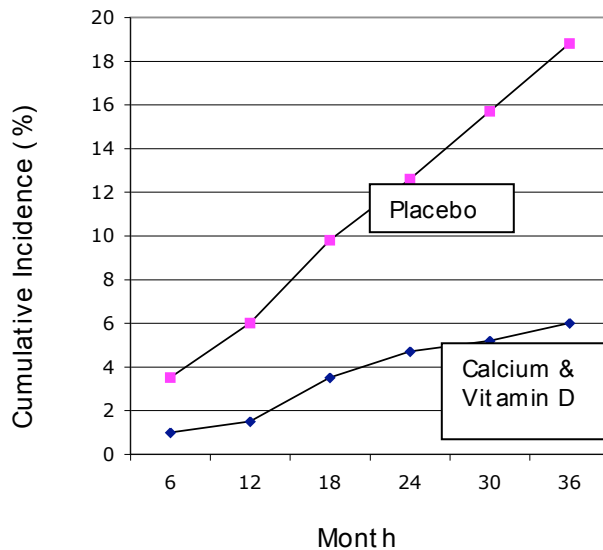
Similarly, for colon cancer. Combining unabsorbed fatty acids and bile acids with calcium reduces their cancer-promoting activity in the mucosa of the colon. Dr. Heaney believes that a person who has a long history of adequate calcium in the diet is much less likely to ever experience colon cancer. It makes sense to me, too.

3. *Hypertension* Abundant calcium also serves to reduce hypertension or high blood pressure. While hypertension is a “disease with many parents”, according to Dr. Heaney it can be effectively managed with increased dietary calcium, reduced fat intake, as well as other nutritional and behavioral modifications. Although anti-hypertension drugs are effective, they are expensive and have side effects. Calcium is inexpensive, has no side effects, and needs no medical prescription. But you should never discontinue your anti-hypertensive medications and switch to calcium on your own. Consult your physician.

#### **Increasing Bone Density: Reducing Fractures**

The evidence suggests calcium will reduce the risk of fracture as long as enough Vitamin D is given with it <sup>(r191)</sup>. As you’ve seen, it’s because Vitamin D<sub>3</sub> increases the absorption of dietary calcium. And Vitamin D has other powers in muscle. It helps prevent falls.

**Figure 8-5: Supplementing with Calcium and Vitamin D Reduced Nonvertebral Fracture Incidence**



**Calcium and Vitamin D work!** This graph comes from a study published by Dr. Dawson-Hughes and colleagues in 1997. It shows that, compared to placebo, elderly

women who took daily Vitamin D<sub>3</sub> at 700 IU with 500 mg of calcium for 36 months showed protection from fracture. Note how the placebo users suffered from breaks in their bones, and how the cumulative rate climbed within 36 months to include 20% of the group. These nutrients can help preserve the bones from fracture as they preserve bone mass. Even higher levels of nutrients provide even better results. At only 500 mg per day of calcium combined with 700 IU of Vitamin D<sub>3</sub> which was considered relatively high for its time, participating women did not gain bone mass, but at least their bones were protected from further age-related and age-expected loss. Would higher quantities of Vitamin D and calcium have done better? It appears likely.

### **Vitamin D and Calcium: Striking the right balance**

The research shows that not only do you need both calcium and vitamin D, you need them in the right ratio.

**High calcium, Low Vitamin D (not right)** A 2004 study compared the regimen of 1000 mg/day of calcium, which is pretty high, combined with 400 IU per day of Vitamin D<sub>3</sub>, which is too low <sup>(r398)</sup>. Under this regimen there was only a partial benefit. Within 4 weeks, the PTH levels did decline as expected from higher calcium in the blood, but blood levels of markers of bone resorption did not decline as hoped

**Calcium, but no Vitamin D (not right)** Similarly, an investigation in 1999 tested 800 mg/day of calcium citrate without any Vitamin D as part of a regimen. <sup>(r659)</sup> After 2 years there had been no change in bone mineral density for those who took the nutrient and a 2.3% decline in bone mass for those who took the placebo, but there had been no reduction in PTH. So once again, only a partial benefit was shown.

What you should know: To meet your changing needs for optimal bone health, you should combine adequate levels of Vitamin D<sub>3</sub> with adequate levels of calcium. What is “adequate” varies with age and with the level of reproductive hormones (estrogen, progesterone, testosterone). At least the 1000 IU per day of Vitamin D<sub>3</sub> combined with 700-1500 mg/day of calcium seems rational.

### **How Much Dietary Calcium (or its Supplement) is Beneficial?**

By 2003, it was clear that the amount of calcium absorption varies with the blood level of Vitamin D found in a post-menopausal woman <sup>(r332-r338-r339)</sup>. Dr. Heaney’s team proved that if you have enough Vitamin D, supplemental oral calcium pills will be adequately absorbed. The

choice then has to do with cost and whether the pill is easy or difficult to swallow.<sup>(r332)</sup> 01 Some pills are gigantic while others are small.<sup>(r338-r339)</sup> They all work. So Vitamin D is the key. Take it with your calcium.

#### Don't Swallow Claims about Soy

Genistein, one particular isoflavone in soy, has been the subject of many published studies. It shares some chemical properties with estrogen and it is known to bind to the estrogen receptors in human beings.<sup>(r534-r137)</sup> The only study to evaluate synthetic isoflavones for long term found no significant changes in bone density from baseline.

The Proof: In summarizing the research in this field, one expert (2004) stated that it is doubtful that short-term use of dietary or supplemental isoflavones is good for skeletal health in post-menopausal women. A year later (2005), the effect of pure genistein on bone markers and hot flashes in 100 post-menopausal patients was published in the International Menopause Society's journal<sup>(r13)</sup>. In comparison with placebo, high doses, 99 mg/day of pure genistein, did not alter the bone markers of resorption or formation at all.

The downside of soy: However, there were negative side effects to taking this high dose of genistein. Both back pain and bloating were significantly more likely to occur in the genistein supplement than the placebo participants<sup>(r13)</sup>. *I do not recommend you rely on these to help your bones.*

#### **Instead Swallow this**

Don't waste your money on soy; instead buy some prunes! An animal study suggested that dried plum (prune) reverses bone loss in ovariectomized rats who had sustained the (expected) post-ovariectomy bone losses<sup>(r210)</sup>. The results suggest that dried plum can completely reverse the loss of both tibial and femoral bone density due to ovarian hormone deficiency in ovariectomized animals.

Since prunes offer other healthy benefits (i.e. preventing constipation that can increase small bowel diseases), there seems to be no harm in adding them to the diet of any woman concerned about maintaining her bone strength after surgical menopause or hysterectomy. On days that you add one serving of (3 or 4 prunes) to your daily diet, this one food would supply both part of your fruit and part of your dairy

need that day. No rigid data are yet available to quantify units. But hopefully you like prunes. They're great for you.

## How Sex Hormones Protect Bones

### Progesterone as a Bone-Preserving Hormone

Progesterone protects your bones. Dr. Jerilyn Prior, a pre-eminent progesterone researcher, showed that bone remodeling is closely related to the ovarian cycle of the fertile years <sup>(r618-r614-r617)</sup>. Her studies provided good evidence that estrogen by itself offers only part of the sex hormone requirement of healthy bones.<sup>(r51)</sup> Dr. Prior believes that to deter postmenopausal bone loss, estrogen is better than no hormone; but *progesterone plus estrogen* is best, resulting in a large gain in bone. <sup>(r292)</sup>

After pre-menopausal ovariectomy, bone resorption greatly overshadows formation.<sup>(r619)</sup> Not good. Bone turnover is increased dramatically above normal pre-menopausal levels post-surgery. Dr. Prior appears to be on target. She describes the benefits of sequential progesterone that mimic the pattern of the ovulatory cycle of bone-replete fertile women. Nature's Design seems to work best for hormones and bone health. Progesterone half the month; estrogen every day.

### Hormone Therapy and Bones

When a post-menopausal woman stops taking estrogen and has not previously been taking progesterone, bone loss is accelerated two-fold higher than in women who were taking progesterone with estrogen <sup>(r613)</sup>. It is essential for women and their physicians to understand the importance of estrogen and progesterone as well as the difficulties that are likely to occur with their abrupt cessation.

Many women, in response to the Women's Health Initiative and its media blitz, were advised to stop taking hormones altogether. The "sky is falling" reaction that ensued was regrettable. Suddenly stopping hormones hurts the bones of intact women – though less severely than it hurts the bones of a woman who had an ovariectomy or hysterectomy. If you are one of the women who stopped taking hormones, get your bone health tested.

**Studying Hormone Regimens and Bone** The evidence has continued to confirm unequivocal benefits of hormonal therapies for the bones of women after their fertile hormone cycle has ended. Our bones are stronger when we're young and deserve more attention as we age.

What you should know: Hormones help bones Scientific literature makes clear that any sex hormone regimen will help bone density, whether estrogen alone <sup>(r804-r563-r294-r230-r484)</sup>, estrogen and a progesterone or progestin <sup>(r294-r122-r820-r95-r542-r608)</sup> or estrogen with an androgen such as testosterone or DHEAS <sup>(r187)</sup>.

What you should know: It's never too late <sup>(r681-r54)</sup> Frail women over the age of 75 given estrogen and progestin experienced an increase in bone mineral density on the total body, the lumbar spine, the total hip, and the trochanter region of the hip. They also showed a 50% reduction in bone resorption compared to only a 20% reduction in bone formation on the regimen that one experimenter used <sup>(r804)</sup>. Although the earlier you start, the better. <sup>(r54-r681)</sup> bone will always appreciate HRT.

### Which Hormone Regimens Are Best?

Most often in the United States a woman who has had a hysterectomy is prescribed estrogen without progesterone. I think this should change. This U.S. pattern contrasts with studies published from Europe, where progesterone is recognized by many researchers as an important component to balance the estrogen.

### Estrogen by itself does benefit bones

What you should know: More estrogen is better The more estrogen provided in the regimen, the greater the increase in, or more secure the maintenance is, of bone. <sup>(r173-r230-r229-r563-r597-r294)</sup> There is clear dose dependency.

The Benefit of Adding Progesterone or Progestins to Estrogen: also dose-dependent.

The higher the P, the better. For example, in 2005, a study tested 1 mg/day of estradiol taken by swallowed pill combined with norethisterone (NET) a synthetic progestin drug widely used in Europe. With estrogen level held constant, the higher the levels of NET added to the estrogen, the better the spinal bone mass improvement. <sup>(r294)</sup>

P combined with E The opposite experiments were also performed. And the higher the level of estrogen that was added to the steady dose of progesterone, the more bone that was gained. (r122-r820-r95)

### Sequential are better than Continuous-Combined Regimens

In a continuous combined regimen, a single pill provides a combination of estrogen and a progestin. This regimen does not mimic the natural reproductive cycle of a woman. It is not Nature's Design. *Sequential regimens provide the P only half the time and appear to be better.*

The Proof: For example, an 18-month double-blind, placebo-controlled trial (r542) found that women taking placebo lost 4.5% of their bone mineral density; but either sequential or continuous combined regimen users *gained* 4% in their bone mineral density over the same 18-month period. The sequential regimens allowed a more economical use of hormones because a better effect could be achieved at a much lower total dose. (r608)

### But if You Have Heart Disease, your Bones May Not Benefit From Prempro®

Results from bone studies of healthy women just described may not apply to women with heart disease. The HERS study tested 2,763 intact women with coronary disease, treating them with either placebo or the continuous combined E and P, Prempro® (r366). More Prempro® than placebo users experienced a fracture during the 7 years of treatment. But the difference was called "statistically non-significant".

What you should know: The longer you used hormones, the better your bones will be as you age. As long as hormones are providing good benefits for you, keep using them. (r564)

### Osteoarthritis and Hormones

People with bone problems often have osteoarthritis. But you may have osteoarthritis and no osteoporosis or vice-versa. The term "osteoarthritis" defines a group of conditions that lead to painful joint symptoms associated with defective cartilage at the bone and changes in the underlying bone at the margins of the joints (r771). Risk factors of osteoarthritis are obesity, aging, joint injury, and prolonged

occupational or sports stress causing cartilage damage <sup>(r37)</sup>. Restricted motion after mild to moderate activity and joint stiffness in the first 30 minutes after awakening signal its presence <sup>(r37-r798)</sup>.

What you should know: Vitamin D helps People with deficient levels of Vitamin D serum had 3 times the risk of developing osteoarthritis at the knee according to data from the Framingham study <sup>(r37)</sup>. And one recent study of 1,500 women over age 55 revealed that deficient serum Vitamin D (< 30 ng/mL) was found in more than half of the women <sup>(r356)</sup>. So again, make a commitment to get your Vitamin D “intake”.

Do hormones help? Hurt? The studies show both! It is known that hormone therapy significantly reduced the severity and loss of the subchondral (beneath the cartilage) bone thickness. However, for women who are obese or women who began using hormone therapy post-menopausally after age 50, the studies are mixed. Some show estrogen reduces osteoarthritis symptoms <sup>(r806-r669)</sup> One showed women with these problems were more likely to using hormones. <sup>(r809)</sup>.

What you should know: Timing is key Studies that ask about estrogen before age 50 have unambiguously shown consistent benefits. Reviewers have agreed that hormonal therapy has limited benefits when administered *after* cartilage degradation has already occurred, but may be protective for those who start hormones early <sup>(r771)</sup>. For example, an Italian study of 43,000 women showed that “ever-users” of hormone therapies were at a decreased risk of osteoarthritis compared with “never-users” <sup>(r771)</sup>.

Osteoarthritis is clearly more common in women who are overweight. Women who were fat at age 40 had about triple the risk of having osteoarthritis by the time they were post-menopausal <sup>(r806)</sup>.

### Bone Saving Drugs

#### Prescription Treatments for Preventing Fractures in Women with Compromised Bones

**Table 8-2: Agents that Reduce Fracture Risk**

All Fractures	Vertebral Fractures
Calcium and Vitamin D	Raloxifene (SERMs <sup>*</sup> )

\* a SERM (Selective Estrogen Receptor Modulator) is a synthetic molecule with some estrogen and other anti estrogen properties

Hormones: Estrogen and Progesterone	Calcitonin
Alendronate, Actonel and Fosamax	

Table 8-2 <sup>(r453)</sup> shows the variety of treatment regimens that are currently approved and marketed for treatment of osteoporosis or osteopenia.

The bone-specific therapies shown in the table--raloxifene®, the bisphosphonates: alendronate, Fosamax®, and Actonel—do offer short-term bone benefits. However, unlike hormones, these therapies fail to benefit the other issues (like vaginal atrophy, blood vessel protection, aging skin and eyes) that a woman who is estrogen-deficient experiences. Prevention of fracture in the long-term appears to involve long-term therapy regardless of treatment. The persistent message for most women, continue your sequential regimen.

For those women who should avoid hormonal therapies, bone-specific therapies may offer benefits.

### **Raloxifene**

Raloxifene reduces vertebral fracture risk in osteoporotic post-menopausal women <sup>(r386)</sup>. It is a SERM, a Selective Estrogen Receptor Modulator. This synthetic molecule, a patented drug, selectively reacts with some, but not all, estrogen receptors. Whether or not the women have already had a vertebral fracture, the results showed Raloxifene worked to prevent future fractures. <sup>(r386)</sup>.

Some Proof: Women who began the experiment with a t-score of -3.1 (see Box on page x) (very osteoporotic) were at the highest risk of developing a new vertebral fracture over the next 3 years. At the end of 3 years, 5.5% of placebo users who had such a low t-score experienced a new vertebral fracture. In contrast, about 2.5% of the women who had been taking raloxifene (60 mg/day) at the end of 3 years had sustained a fracture. A little over 5% was cut to a little over 2%. <sup>(r385)</sup>

You should know: Drugs alone may not be enough Clearly, a drug can help. I would add that studies like this are not designed to simultaneously advise the women to exercise or change their nutrients to prevent fractures.

I say, make lifestyle changes first. Then decide on the drugs.

### **Bisphosphonates: Alendronate, Actonel and Fosamax®. Do they Help?**



Drugs that work as anti-resorptive agents appear to reduce the fracture risk to below pre-menopausal low-risk fracture rate. However, over-suppression confers a potential risk because theoretically micro-damage—micro cracks—would accumulate. Mineralization would increase and theoretically increase risks of damage to the bone that is present <sup>(r453)</sup>.

You should know: Bisphosphonates work; but long-term effects are unclear. They definitely reduce loss of bone mass and produce a significant 30% to 50% reduction in new vertebral fractures. <sup>(r89)</sup> In studies examining bone mineral density in the lower spine, the bisphosphonate alendronate better maintained or gained bone mineral density than raloxifene. <sup>(r472)</sup> However, the molecules of alendronate attach themselves to the bone tissue, accumulating in bone. <sup>(r818)</sup> Because these are “foreign particles” not naturally produced by the human body, the long-term effects cannot be determined until the drugs have been consumed for many years, and the adverse effects are recognized and reported. Osteonecrosis (disfigurement) of the jaw is one such recently discovered adverse effect. <sup>(r282)</sup>

Compared to hormone therapies, bisphosphonates have significant gastrointestinal side effects. And they are not adequate substitutes for estrogen with regard to organ systems other than bone <sup>(r644)</sup>.

You should know: Hormones are better Compared to estrogen with progestin, taken either sequentially as NET 10 days per month or continuously as MPA at 5 mg per day, both hormone regimens were superior to alendronate at 2.4 or 5 mg per day <sup>(r358)</sup>. After 1 and 2 years of treatment, neither dose of alendronate prevented bone loss in the distal forearm. But either dose of hormones did prevent loss. But bisphosphonates are generally effective for bone, according to research that has examined up to 10 years of use <sup>(r453)</sup> .

For this reason, physicians who treat bone patients recommend keeping them on bisphosphonates up to 7 to 10 years, only if they have osteoporosis, not the less severe osteopenia <sup>(r453)</sup>. Dr. Lindsay considers a “drug holiday” after 5 years a useful precaution if the blood levels of the various bone markers show that bone turnover is remaining well within the drug-induced pre-menopausal range.

These drugs are expensive, costing more than double the cost of hormonal therapy. Once Fosamax® goes off patent in 2007, generic manufacturers will begin

producing much cheaper substitutes for it. Issues of generic equivalence and quality control, might then warrant discussion because major pharmaceutical companies offer great quality control. For now, I think they are worth considering, only if you cannot take HRT.

### Calcitonin

In the early 1980s, there was high hope for the use of calcitonin hormone to help the bone-*building* component of the remodeling cycle. Unfortunately, for women who are osteoporotic, calcitonin has shown only a small (20%) reduction in the risk of new vertebral fractures and no effect on non-vertebral fractures (like the hip)<sup>(r89)</sup>. For this reason, calcitonin is not currently in wide use.

### Parathyroid Hormone

The anti-resorptive therapies just described effectively reduce bone turnover to maintain micro-architecture, improve mineralization, and increase the bone mineral density. But they do not reconstruct bone.

Parathyroid hormone (PTH), an anabolic hormone, does not block resorption of bone. So it is not an anti-resorptive therapy. Rather, it triggers the formation of new bone tissue. The drug *teriparatide* is a fragment (a part of the molecule) of human PTH and is FDA-approved for treatment of osteoporosis. Unfortunately, it has a black box warning on every package handed to the consumer for an increased risk of osteosarcoma (cancer of the bone) in rats. So it's not a "magic" bone solution.

This PTH drug with the trade name Forteo® increased bone mineral density and significantly reduced the risk of new fracture (65% reduction in the vertebral and 53% in the nonvertebral) in osteoporotic women who had had previous vertebral fractures<sup>(r89-r74)</sup>. It requires daily self injections.

This tricky regimen requires careful medical monitoring. *But it does work* when an expert clinician switches the patient to other drugs after 2 years of use<sup>(r74)</sup>.

What you should know: You may need PTH and then drugs Women who took this PTH drug experienced fewer fractures and also substantial increases in bone mineral density. However, after stopping the PTH at 2 years, they experienced substantial

bone loss unless anti-resorptive drugs were taken <sup>(r74)</sup>. So 2-year use of PTH shows promise for post-menopausal osteoporotic women under careful medical management.

## CONCLUSIONS

### General Recommendations for Maintaining Bone Strength

1. **Exercise Regularly:** Maintain your balance and fitness through regular activity. Almost any local YMCA or the National Osteoporosis Foundation's website ([www.nof.org/prevention/exercise.htm](http://www.nof.org/prevention/exercise.htm)) would be a good resource. Every woman, and especially those who are at risk for fragility fractures, should also exercise daily by participating in regular weight bearing exercises, such as walking. A daily 20 to 30 minute walk should be a *minimum* part of every woman's exercise regimen. Walk while you shop or do housework. But ideally get out in the fresh air under that big sky, so that the walk will combine with UV-B exposure and good respiration to enhance your overall health along with your muscles. And practice good posture!
2. **Stop Smoking!** Smokers should quit. There are many ways you can get help to break this bad habit. See pgs YY
3. **Control Alcohol Consumption:** Enjoy alcohol in moderation but not in excess because inebriation can lead to falls. One or two drinks per day have not been shown to increase the risk of osteoporosis or fractures, are good for you, and will probably increase the joy in your life.
4. **Practice Good Nutrition:** Eating a healthy, well-rounded diet of wholesome, unprocessed food is part of a general healthy life. That includes getting enough calcium every day to at least compensate for what gets excreted (about 600-700 mg/day). Although many of the green vegetables do contain high levels of calcium, some, unfortunately, do not release their calcium for absorption. So it is then excreted. Assess your need for a calcium supplement if your diet isn't supplying enough. Take a Vitamin D<sub>3</sub>, at least 1000 IU per day.
5. **Create Safe Surroundings:** An environmental risk assessment of your living quarters and other spaces is a wise precaution. Get rid of tripping hazards. Plug nightlights into sockets in areas you will navigate at night.

6. ***Consider Hormone Therapies First; Drugs Second*** Pharmacologic agents should be considered if and when appropriate. Hormonal or bisphosphonate therapy can halt excessive resorptive breakdown of bone. Progesterone use, preferably sequentially, with regular estrogen can trigger new bone formation.