

Boning up on

This crippling disorder isn't an inevitable consequence of aging. Take steps now that will keep your patients on their feet throughout life.

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IMAGINE THAT YOU'VE RECENTLY cared for the following patients in your medical/surgical unit:



- Julia, 17, who's recovering from an appendectomy. She worries about missing the rest of volleyball season and the start of basketball practice. You notice that she's very thin, but she reports regular menstrual periods.
- Beth, 41, who had her broken wrist surgically repaired earlier this evening. During your

admission assessment she reports that her periods are becoming irregular.

- Mark, 46, admitted after a severe asthma attack required intubation and several days in the intensive care unit.
- Lucille, 78, recovering from hip replacement surgery. She appears frail and stooped. She jokes, "I get shorter every year!"

You'd probably think about osteoporosis in Lucille's case, but did you know your three younger patients may be at risk too?

More than 10 million people in the United States—80% of them women—have osteoporosis, which literally means porous bone. Another 18 million have osteopenia, or abnormally low bone density, placing them at risk for developing osteoporosis. Every year, osteoporosis has a hand in about 1.5 million fractures.

In this article, I'll tell you why osteoporosis develops, what signs and symptoms to watch for, and how you can help your patients protect themselves from crippling injuries. But first, let's strip the physiology down to the bare bones.

Taking a hard look at bone loss

A dynamic connective tissue, bone constantly remodels itself through bone resorption (loss of calcium from bone) and reabsorption (buildup of calcium in bone, or remodeling). Cells called osteoclasts break bone down; cells called osteoblasts remodel it. In a healthy adult, a complete remodeling cycle takes about 4 months; in someone with osteoporosis, remodeling may take 2 years.

Osteoporosis occurs when the rate of resorption is greater than the rate of bone formation. It's characterized by a greater loss of trabecular bone—the honeycomb-like meshwork found in vertebral bodies and inside bones—than of cortical bone, the hard outer layer. The loss of trabecular bone leads to injuries typical of osteoporosis: vertebral crush injuries, fracture of the neck of the femur, and fractures at the distal end of the radius.

Although age-related trabecular bone loss is similar for men and women, the underlying causes differ. In menopausal women, lack of estrogen leads to increased resorption. In men, trabecular bone thins because of reduced bone formation. This pattern of bone loss reduces the relative risk of fracture for men.

osteoporosis

Calcium is normally absorbed by the blood from the digestive system and deposited into the bones. In osteoporosis, blood levels of calcium are slightly low due to dietary calcium deficiency, the inability of intestines to absorb calcium, or the lack of estrogen in the body as in postmenopause. To maintain calcium in the blood, resorption from the bones increases and causes osteoporosis.

Normal absorption of calcium by intestines

Besides enhanced bone resorption, low blood calcium increases the effects of two other factors: parathyroid hormone (PTH) and vitamin D. Both stimulate calcium absorption from the intestine and increase resorption from bone. The result is an increased sacrifice of calcium in the bones to maintain normal levels of calcium in the blood.

Ineffective absorption of calcium by intestines

Parathyroid glands are found behind the thyroid and produce PTH.



Vitamin D is supplied by the diet and produced in the skin as a reaction to sunlight. It is processed into a very potent form in the liver and kidney.



Cortical bone

Increased calcium resorption from bone

Ca⁺⁺

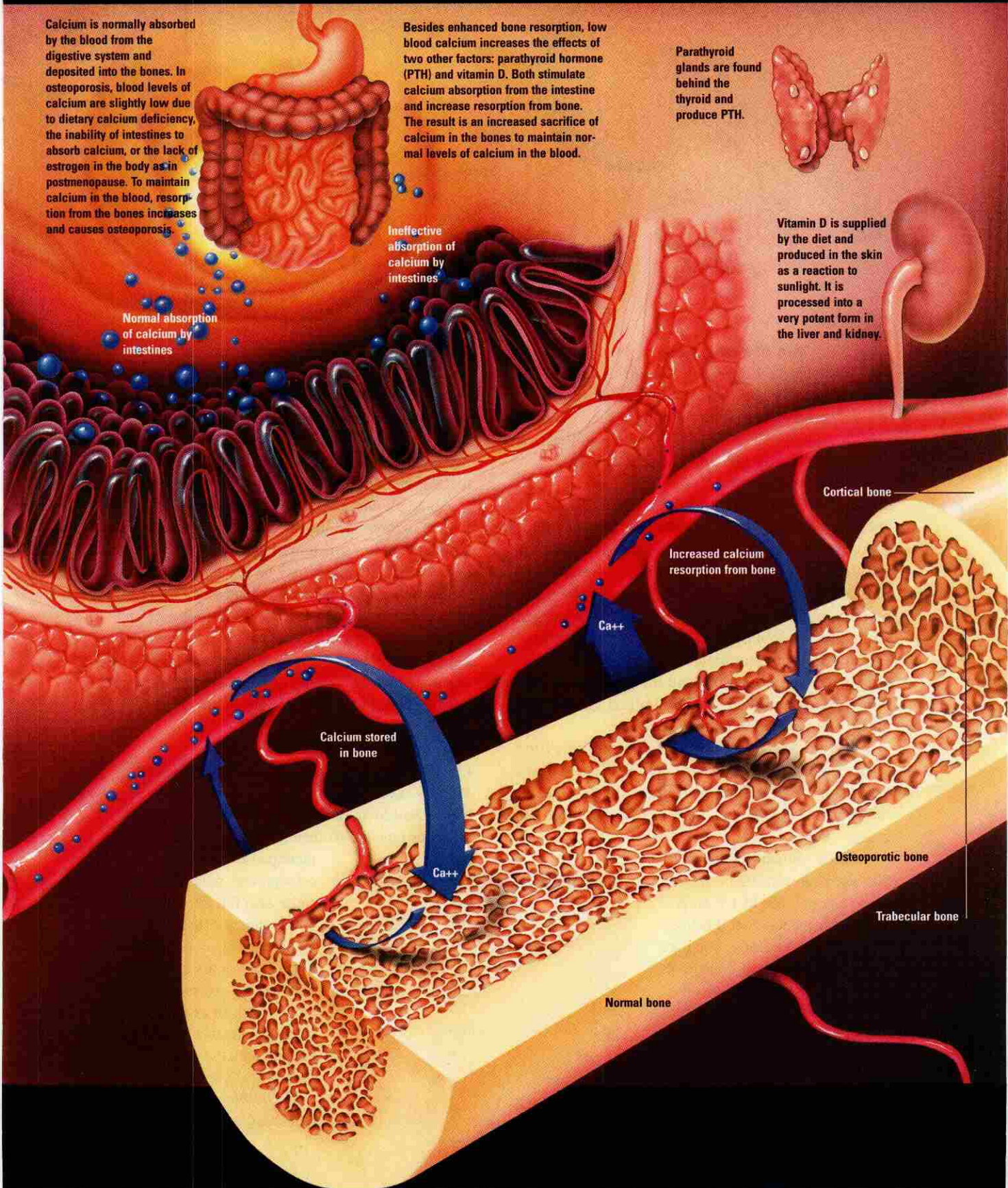
Calcium stored in bone

Ca⁺⁺

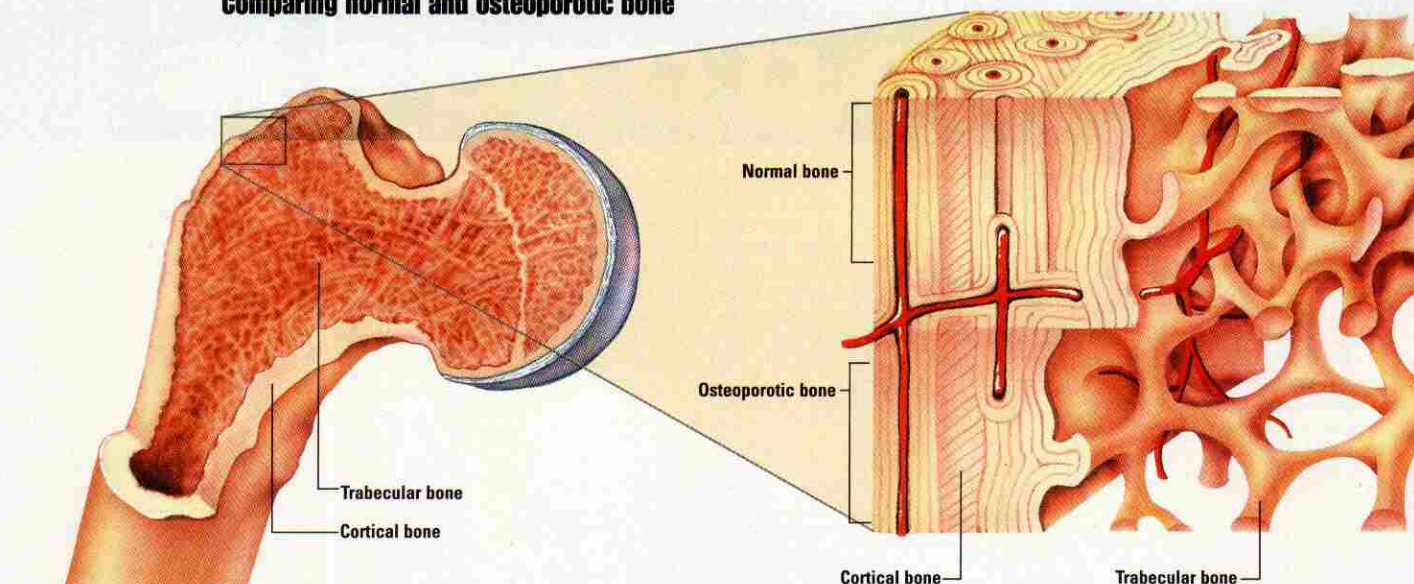
Osteoporotic bone

Trabecular bone

Normal bone



Comparing normal and osteoporotic bone



The life of bone

Throughout our lives, our bones are constantly being broken down and rebuilt in a process called remodeling. (See *Taking a Hard Look at Bone Loss*.) Cells called *osteoclasts* break bone down; cells called *osteoblasts* remodel it.

When bone is broken down, calcium and other essential minerals stored in bone are released into the bloodstream. Some of this calcium is used throughout the body, but most is used for bone remodeling.

Bone mass is influenced by estrogen, physical activity, nutrition, and metabolic factors. Estrogen stimulates osteoblasts and suppresses osteoclasts. Physical activity stimulates bone growth from the tension of weight bearing and the pull of muscles on bone. Adequate intake of calcium and vitamin D ensures bone growth and preservation.

Bone mass changes throughout a person's life span, doubling between birth and age 2 and doubling again by the time a child is 10 years old. By the time he's 18, he has 90% of his maximum bone mass.

When a woman is in her mid-30s, she begins losing bone mass at the rate of 0.5% to 1% every year. After menopause, this loss speeds up dramatically: She may lose up to 15% of her bone mass in the 5 years following menopause. This is the equivalent of one-third of a woman's lifetime bone loss. By her late 80s, a woman may have only half the bone mass she did when her bones were at their peak.

Men are vulnerable too

Although often considered a woman's problem, osteoporosis threatens men too. One to two million men in the United States have osteoporosis, and up to 13 million have osteopenia. The risk of experiencing an osteoporosis-related fracture at some time in life is 13% to 25% for men.

Although men begin losing bone mass by the time they're in their late 30s or early 40s, the loss is more gradual than in women until the age of 65. But after this age, a man's bone loss may be greater than a woman's.

Except for menopause, risk factors are the same for men as for women. Low levels of testosterone and luteinizing hormone may add to the risk. A man may have no symptoms or notice a decreased libido, impotence, or decreasing body or facial hair. Blood testing can diagnose or rule out low hormone levels.

Primary or secondary?

Osteoporosis can be either primary or secondary. Primary osteoporosis involves trabecular bone loss, usually related to an estrogen deficiency. Most patients with this type are women in the first decade after

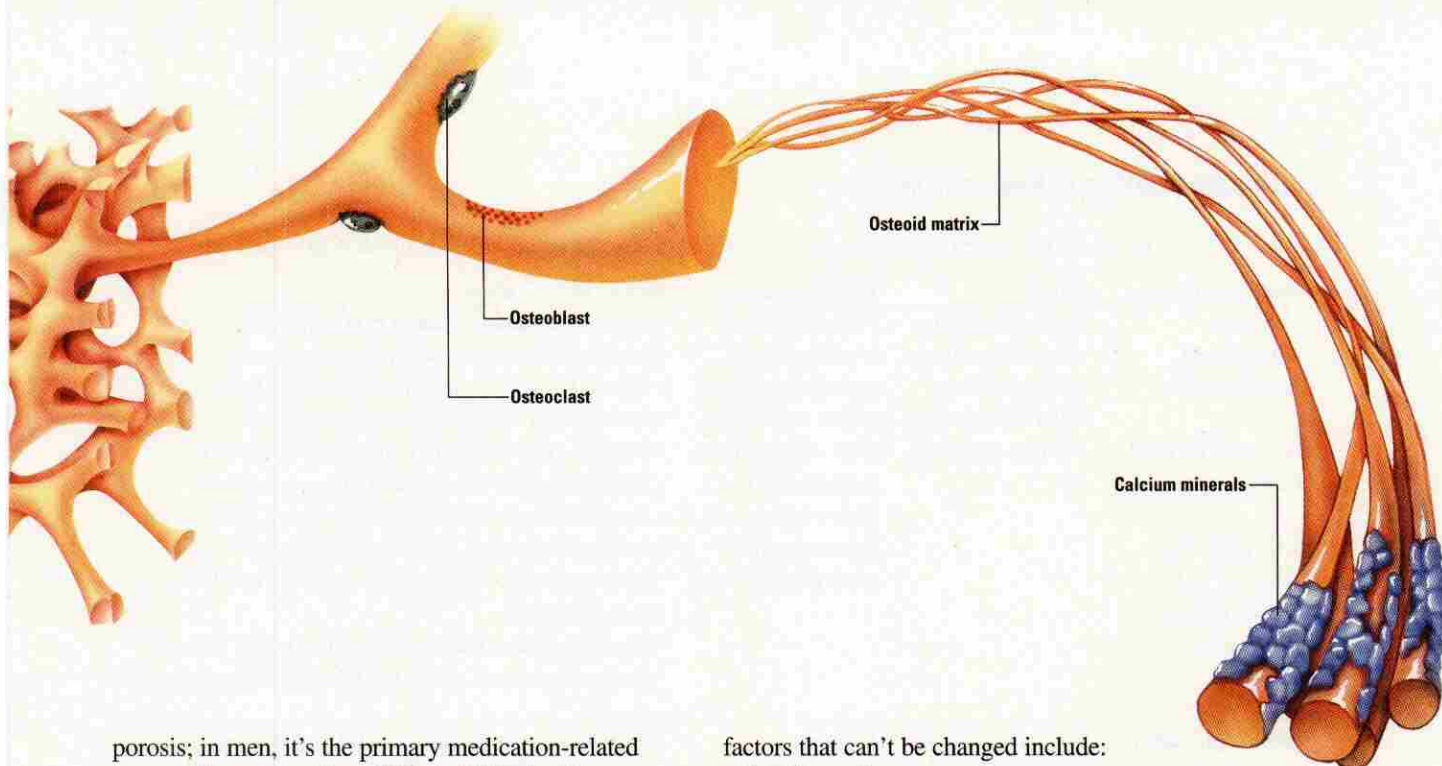
menopause. Men who develop osteoporosis without a known cause also fall into this group.

Secondary osteoporosis, which involves cortical and trabecular bone loss, occurs in association with certain diseases and treatments, such as cancer, hormonal or gastrointestinal disorders, alcoholism, anticonvulsants, glucocorticoids, and chemotherapy.

Corticosteroid use is an important cause of secondary osteo-

Recommended daily calcium intake

Age (years)	Recommended amount (mg/day)
1-3	500
4-8	800
9-18	1,300
19-50	1,000-1,200
51 and over	1,500
Pregnant/lactating women	1,200



porosis; in men, it's the primary medication-related cause of bone loss. From 30% to 50% of patients treated chronically with systemic steroids develop skeletal fractures. Even low doses of corticosteroids are associated with accelerated bone loss and increased fracture risk. The most rapid bone loss occurs during the first 6 to 12 months of systemic therapy, and the loss continues at a slower rate with prolonged therapy. Recent research shows that therapy with a bisphosphonate (alendronate or risedronate) can reduce and treat steroid-related bone loss.

Osteoporosis that develops after age 70 is called *senile osteoporosis*. Affecting both men and women, it's related to decreased calcium and vitamin D intake and lack of activity.

Many factors increase the risk of osteoporosis. Risk

factors that can't be changed include:

- female gender
- age (the longer you live, the higher your risk)
- family history (if a close relative has had osteoporosis, you're at higher risk)
- ethnic group (white and Asian women are at highest risk; African-American and Hispanic women have a lower risk)
- small-boned body frame
- late first menstrual period (later than age 12 to 14, depending on family history)
- irregular menstrual periods, oophorectomy, and early or current menopause, all associated with low estrogen levels.

Among risk factors that can be modified, immobilization (from bed rest or paralysis) and lack of exercise

Straight talk about supplements

The best way to get the recommended daily amount of calcium is from a well-balanced diet. But if your patient's diet isn't adequate, suggest that she take a supplement. Teach her the following points:

- Unless you're getting vitamin D from another source, such as a multivitamin, choose a supplement containing vitamin D, which enhances calcium absorption.

Choose supplements that have been tested for lead content. A recent study found that some calcium supplements contained half the recommended dietary daily lead limit.

- Also be aware of factors affecting

calcium absorption. Take calcium carbonate with meals, as stomach acid will help the medication dissolve entirely. It interferes with iron absorption, so don't take it with an iron supplement. Calcium citrate may be taken anytime, as it's more readily dissolved than calcium carbonate.

- Take calcium throughout the day; your body can't absorb more than 500 mg at once.
- If you experience abdominal distress, try switching forms (carbonate instead of citrate or vice versa), taking half a tablet at a time, taking the supplement at different times of day, or taking it with meals.

If the label doesn't indicate that the supplement is up to U.S. Pharmacopeia standards, do a short test to make sure that the tablets will dissolve. Put a tablet in a cup of vinegar and stir occasionally. If the tablet doesn't dissolve in about 30 minutes, it won't dissolve in your stomach.

- Don't take more than the recommended amount each day. If you eat many calcium-fortified foods and take supplements, you may get more than 2,500 mg of calcium every day. Excess calcium can block absorption of other minerals, cause constipation or an upset stomach, and cause kidney stones.

Using medications to treat osteoporosis

The following medications increase bone mass and decrease the risk of fractures. Here's how they compare.

Medication/Forms	Action	Adverse reactions	Nursing considerations
Hormone replacement therapy (HRT): Premarin, Prempro, Estratab, Estrace <i>Oral tablet, skin patch, or vaginal cream, ring, or suppository</i>	Suppresses osteoclasts, may stimulate osteoblasts; helps body absorb and conserve calcium	Menstrual-like bleeding, water retention, cramps, breast tenderness; with long-term use, increased risk of breast cancer and other estrogen-dependent cancers	<ul style="list-style-type: none"> • May be indicated if patient is at high risk for osteoporosis or has severe menopausal symptoms • Contraindicated if patient is at high risk for breast or uterine cancer, has abnormal uterine bleeding or liver disease, or has a history of or risk for blood clots • Rapid bone loss may occur if discontinued • Decreases low-density lipoprotein (LDL; "bad cholesterol") and increases high-density lipoprotein (HDL; "good cholesterol"). Cardiovascular risks and benefits are controversial. • Warn the patient that smoking while taking HRT increases the risk of stroke or myocardial infarction.
Bisphosphonates: alendronate (Fosamax), risedronate (Actonel) <i>Oral</i>	Suppresses osteoclast activity	Nausea, indigestion	<ul style="list-style-type: none"> • Indicated if patient can't take HRT or as therapy after patient stops HRT • Contraindicated if the patient has ulcers or upper gastrointestinal (GI) disorders • Should be taken indefinitely • To minimize adverse GI effects and maximize absorption, teach the patient to take the medication on an empty stomach with a full glass of water. Tell her to remain upright and to refrain from eating or drinking for 30 minutes.
Selective estrogen receptor modulator: raloxifene (Evista) <i>Oral</i>	Decreases bone turnover and reduces bone resorption	Hot flashes, leg cramps, swelling of legs and feet, blood clots (rare)	<ul style="list-style-type: none"> • May be indicated if the patient can't take HRT; a good alternative if she has a strong family history of breast or uterine cancer • Contraindicated if patient is premenopausal or already taking HRT, has liver disease, or has a history of or risk for blood clots • Decreases LDL; increases HDL • Doesn't increase the risk of breast or endometrial cancer • Teach the patient to notify her primary care provider if she develops breast tenderness or vaginal bleeding, as these aren't expected adverse reactions.
Calcitonin (human): Cibacalcin (injection) Calcitonin (salmon): Miacalcin, Calcimar <i>Injection or nasal spray (Miacalcin Nasal Spray)</i>	Directly inhibits bone resorption of calcium; suppresses osteoclast activity	<i>From nasal spray:</i> itchiness or irritation of nostrils <i>From injection:</i> tenderness at injection site, nausea, facial flushing	<ul style="list-style-type: none"> • May be indicated if patient has pain from vertebral fractures; this medication relieves this pain after 2 to 4 weeks of therapy • May be indicated if patient can't or won't take HRT or alendronate; may be used in combination with other medications to treat severe or intractable osteoporosis • Contraindicated if patient is hypersensitive to the medication; calcitonin (salmon) contains a protein that can trigger allergic reactions in sensitive people • If the patient is using the nasal spray, tell her to alternate nostrils daily.

speed bone loss from lack of stress on the bones. Astronauts experience the same phenomenon during periods of weightlessness.

Certain medical conditions affect calcium absorption, metabolism, or the process of bone breakdown and rebuilding, increasing the risk of osteoporosis. Examples include rheumatoid arthritis, thyroid disorders, poorly controlled Type 1 diabetes, chronic digestive disorders, and lactose intolerance.

Yo-yo dieting and eating disorders (anorexia nervosa and bulimia) increase the risk of osteoporosis because bone is lost along with muscle and fat during dieting and calcium intake may be inadequate. A female who loses so much weight that her menstrual periods stop isn't producing enough estrogen to prevent bone loss. Women athletes who diet and train to decrease fat and increase muscle mass also are at risk.

When assessing a patient like Beth, ask about any history of dieting or eating disorders; people who suffer from eating disorders in their teens and early 20s may never reach optimal bone mass.

A history of fracture after age 40, even if related to an accident, may indicate osteoporosis or a higher risk of developing the disease. Beth now has this risk factor too.

Many medications affect bone mass. Mark has used steroids throughout his life to treat his asthma, and this puts him at a higher risk of developing osteoporosis. Other medications that may decrease bone mass include thyroid hormones, seizure medications, gonadotropin-releasing hormone antagonists, antacids that contain aluminum, long-term use of heparin or warfarin, and certain cancer-treatment medications. Caffeine intake also may be a risk factor, but this is controversial.

You might think pregnancy and breast-feeding would increase the risk, but studies have shown that bone mass is restored within 6 months to a year after pregnancy or breast-feeding ends, even after many pregnancies or extended lactation. One study even found that breast-feeding may protect against osteoporosis later in life.

Subtle signs

Signs and symptoms of osteoporosis are subtle; for many people, a fracture is the first sign of trouble. Other telltale signs include the loss of more than

1½ inches (3.75 cm) in height, spinal curvature (indicating vertebral crush fractures, which may or may not be painful), and chronic or acute pain in the upper or middle back. Advise patients to discuss risk factors and symptoms with their primary care provider.

A bone mineral density (BMD) test, which measures the amount of mineral in a specific area of bone, is the only way to diagnose osteopenia or osteoporosis and also is the best predictor of fractures in the future. The World Health Organization defines osteoporosis as a BMD of more than two and a half standard deviations below the mean bone mineral content for young adults. (Standard deviations measure difference from an average score.) A measurement of more than one standard deviation but less than two and a half indicates osteopenia.

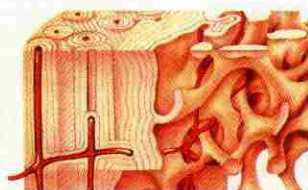
Who should be tested, and when? Although no standard guidelines have been established, testing is generally indicated in these circumstances:

- before a patient begins treatment for bone loss (to evaluate the effectiveness of the treatment)
- when symptoms or significant risk factors for osteoporosis are present
- when a woman is in perimenopause or has gone through menopause (for baseline BMD measurements).

Based on these criteria, you should suggest that Beth, Mark, and Lucille talk with their primary care providers about having a bone density test. Julia currently has no risk factors for osteoporosis.

Starting early

It's never too early to start protecting against osteoporosis. During childhood and adolescence, the focus should be on building bone mass. The most important measure to take during these years is encouraging children to eat high-calcium foods. Teach parents to encourage regular exercise to build strong bones and establish healthy lifestyle habits. Also inform them about eating disorders and the risks of excessive dieting or exercise. Educate all patients about the dangers of alcohol consumption and smoking, which also contribute to osteoporosis. A woman who smokes may be motivated to quit if you tell her that women who smoke reach menopause with 10% less bone mass



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than nonsmokers.

For patients in their mid-20s to around age 35, focus on maintaining optimum bone mass. Tell patients to continue eating high-calcium foods and to consider adding a calcium supplement to their diet (see *Straight Talk about Supplements*). Weight-bearing exercises, such as weight lifting, jumping rope, walking, and aerobics, help build and maintain bone mass.

After about the age of 35, people should focus on preventing bone loss. Encourage patients to start or maintain a bone-healthy diet and exercise regimens.

Encourage patients to talk with their primary care provider about BMD tests. Menopausal women should discuss whether to begin hormone replacement therapy (HRT) or other medications to prevent or treat osteoporosis (see *Using Medications to Treat Osteoporosis*).

Elderly patients like Lucille who already have osteoporosis may benefit from medication and a supervised weight-bearing exercise program. Talk with her and her family about protecting her from falls by keeping her environment well lit, installing shower handholds and a raised toilet seat, and eliminating household hazards, such as throw rugs.

Challenge patients of all ages to make a chart to

keep track of foods they eat, with a goal of eating 100% of calcium recommended each day (see *Recommended Daily Calcium Intake*).

Teach patients how to interpret labels. For example, if a label indicates that the product contains 20% of the daily recommended calcium, the product contains 20% of the recommended amount for adults ages 19 to 50, or 200 mg. For patients in other age-groups, 20% isn't accurate.

Begin a collection of handouts, books, videos, and other educational items about osteoporosis and give them to your patients. You can make a difference in their lives for years to come. **1**

SELECTED REFERENCES

Guelnder, S., et al.: *Preventing and Managing Osteoporosis*. New York, N.Y., Springer Publishing Co., 2000.

Iqbal, M.: "Osteoporosis: Epidemiology, Diagnosis, and Treatment," *Southern Medical Journal*. 93(1):2-18, January 2000.

Nelson, M.: *Strong Women, Strong Bones: Everything You Need to Know to Prevent, Treat, and Beat Osteoporosis*. New York, N.Y., G.P. Putnum's Sons, 2000.



SELECTED WEB SITE

National Osteoporosis Foundation
<http://www.nof.org>

Last accessed on August 30, 2001.

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