YOGA RESEARCH

The Yoga Research Society Newsletter Number 26 April – September 2001

Looking at Bones

excerpted from *Food and Our Bones* by Annemarie Colbin

How bones develop from a few cells is, like life in general, quite miraculous. In the embryonic stage, they start off as cartilage, something similar to a very firm gel, taking the same shape as the future bones. The cartilaginous skeleton is completely formed at the end of the first trimester of pregnancy. Specialized cells in the center of the long bones, in the *diaphysis* or "shaft," start actual bone formation growing toward the ends, or the *epiphyses*, while cells there also begin to ossify, or turn into bone.

By the time the baby is born, the bones have hardened most of the way, except for a disk of cartilage between the shaft and the epiphyses. This disk is called the *epiphyseal disk* or *growth disk*, and it allows the bones to keep growing until between the ages of 14 and 20, the different bones slowly ossify and fuse the gap to halt growth.

Also during embryonic life, the center of the long bones becomes hollowed out to make room for the cylindrical *marrow cavity*. In the adult skeleton, the walls around the marrow cavity are dense, hard, and compact, and called, appropriately, *compact bone*. The epiphyses, as well as the vertebrae, pelvis, and ribs are not so dense, and contain strands of bone that crisscross haphazardly, called *trabecular bone*; in between these strands there is red bone marrow, which forms red and white blood cells. At birth the marrow in the long bones is red as well, but eventually this is replaced with yellow marrow, which consists of minerals, connective tissue, and fat cells.

Bones are composed of a latticed protein grounding or *collagen matrix*, which comprises about 35 percent of the bone and which gives it its flexibility. This matrix then traps the mineral salt *calcium phosphate*, which occupies about 65 percent of the bone mass and which gives the bone its strength. However, even though strong and hard, bones are not the equivalent of stones or rocks. Instead, like the rest of the tissues in the body, they are constantly moving and changing. They are continuously being built up, in a process called *deposition* or *formation*, and just as continuously being broken down, a process called *resorption*. About 5 to 10 percent of bone is replaced yearly in this fashion. From birth until sometime in our twenties, bone is built up faster than it is

broken down. Between ages twenty-five and thirty, it is considered that we have reached "peak bone mass," and from then on bone resorption is slightly higher than deposition. At first, we may lose around 0.5 to 1 percent of bone per year. After menopause, bone loss may accelerate to between 1.5 and 5 percent per year, depending on a woman's nutrition, exercise, pharmacological drug intake, and overall health.

Being rich in calcium and hardness is not enough to make bones resistant to fracture. Bones can be dense yet brittle, lacking flexibility, which will cause them to break easily. The collagen matrix is crucial for maintaining flexibility, and may be more essential to preventing fractures than calcium content.

In laboratory studies, if a bone is put in an acid bath and all the calcium is removed, it can then be bent and twisted like a tendon; it does not break. On the other hand, a dense, highly mineralized bone that has a collagen matrix diminished can break with slight pressure, or shattered under a sharp blow. For this reason, the tests that measure bone density will not accurately predict the risk for fracture. There are cases of women with demonstrated low bone mineralization, who in spite of repeated falls never break a bone: that is because their bones are *flexible*.

Bones are a reservoir of numerous other minerals that our bodies need for their day-to-day function, besides calcium. For that reason, the remodeling process is essential to our general health. Our bones, in fact, act a little like a "bank." Nutrients come and go as a continuous "cash flow" of "income" and 'expenses." Calcium is the major element in this flow, together with phosphorous, sodium, magnesium, and protein.

Calcium is the most abundant mineral in the body, and is absolutely essential for many physiological functions. Bones contain about 99 percent of all the calcium in the body; the rest is used throughout the body in functions such as blood clotting, nerve transmission, muscle contraction and growth, heart function, general metabolism, and various hormone functions.

In the bones, the calcium is found in the form of *calcium phosphate salts*, not as pure calcium. About 85 percent of the body's phosphorous is stored in the bones. The ratio of calcium (Ca) to phosphorous (P) in these salts is 2.5 to 1. In addition to the calcium and phosphorous, our bones also store between 40 and 60 percent of our body's total sodium and magnesium.

Let's remember that if a little is good and a deficiency is bad, a lot is not necessarily

YOGA RESEARCH

YOGA RESEARCH is published by the Yoga Research Society
341 Fitzwater St., Philadelphia, PA 19147
Phone (215) 592-YOGA Fax (215) 574-1210

Yoga Research Society
341 Fitzwater Street
Philadelphia, PA 19147

Non-Profit Organization
U.S. Postage
PAID
Philadelphia, PA
Permit No. 2935

A merry heart doeth good like a medicine:
but a broken spirit drieth the bones.

Proverbs, 17:22

A **YOGA RESEARCH** subscription is $5.00 per year (two issues). Back issues are available at $3.00 each.

Printed on Recycled Paper

better; in fact, a lot can be bad, too. Lack of enough calcium prevents bone deposition and contributes to thinner bones. Too much calcium can encourage kidney stones and gall stones. Insufficient phosphorous prevents the body from creating the necessary calcium salts and weakens the bones; excess phosphorous in the form of phosphoric acid (found mainly in soft drinks, preservatives, and meats) can stimulate the release of calcium from the bones and thereby weakens them as well.

The source of both calcium and phosphorous are the foods we eat. First, these foods are broken down in the stomach and duodenum, the upper part of the small intestine; then, as the food travels through the remaining twenty or so feet of it, the minerals are absorbed through the walls of the small intestine straight into the blood stream. Once in the blood, the calcium can go straight to the bones and be deposited there for storage. Bone resorption takes place as needed, liberating calcium for necessary functions in the blood, muscles, nerves, heart muscle, and elsewhere.

What is the main element that keeps this input/output system moving? It's activity. Movement, walking, and the influence of gravity all help the deposition of calcium in the bones. Lack of use prevents the deposition of calcium salts, so that the process of mineral resorption slowly uses up the available bone mass.

The body needs to move. Because of the way it is designed, walking is the movement that most efficiently puts just enough gentle strain on the bones to promote their continued reformation. When the heel hits the ground while walking, vibrations travel the length of the leg bones, and the stress creates a piezoelectric effect all along them, keeping the bone crystals together as well as attracting nutrients from the blood and encouraging them to be deposited onto the bone.

Weight lifting, weight training, or just regularly lifting heavy things is very important for the buildup of bone. One study in a nursing home had sedentary older women start their exercise by lifting soup cans. There were significant increases in strength and mobility. A study in Japan showed that water exercise, if consistently practiced, also increases bone mineral density and encourages more general daily physical activity.

Breathing deeply, as most exercisers are apt to do, will indirectly protect the bones by reducing metabolic acidosis. Yoga and Tai Chi are excellent exercise systems for flexibility, balance, posture, and strength; they are generally gentle and easy, ideal for people of all ages.

Annemarie Colbin will be one of the featured speakers at the Yoga Research Society Conference (November 10-11, 2001)