

Strontium: Breakthrough Against Osteoporosis

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by Ward Dean, MD

Mention strontium to most people, and they will almost always immediately think of strontium-90, a highly dangerous, radioactive component of nuclear fallout produced during atmospheric testing of nuclear weapons in the 1950s. As a result of above-ground nuclear testing, radioactive strontium spread throughout the environment and contaminated dairy products and other foods, and subsequently accumulated in the bones of both children and adults.

The media made us well aware that strontium-90 could cause our bones to become radioactive, causing cancer or some other horrible disease as a result. So, in the minds of many, strontium is a poison to be avoided, just like other toxic metals such as lead, mercury, cadmium and aluminum.

However, stable strontium—meaning nonradioactive—is nontoxic, even when administered in large doses for prolonged periods. It also appears to be one of the most effective substances yet found for the prevention and treatment of osteoporosis and other bone-related conditions.

Furthermore, repeatedly administering stable strontium can even gradually eliminate radioactive strontium from the body. The stable form slowly replaces the radioactive form in bone, and radioactive strontium is excreted in the urine.

Strontium is element number 38 of the periodic table of elements. It was discovered in 1808 and was named after Strontian, a town in Scotland. Strontium is one of the most abundant elements on earth, comprising about 0.04 percent of the earth's crust. At a concentration of 400 parts per million, there is more strontium in the earth's crust than carbon. Strontium is also the most abundant trace element in seawater, at a concentration of 8.1 parts per million. The human body contains about 320 mg of strontium, nearly all of which is in bone and connective tissue.

Strontium is in row IIa of the periodic table, just below calcium. Like calcium, strontium has two positive charges in its ionic form. Because of its chemical similarity to calcium, strontium can replace calcium to some extent in various biochemical processes in the body, including replacing a small proportion of the calcium in hydroxyapatite crystals of calcified tissues such as bones and teeth. Strontium in these crystals imparts additional strength to these tissues. Strontium also appears to draw extra calcium into bones. When rats or guinea pigs are fed increased amounts of strontium, their bones and teeth became thicker and stronger.

Strontium has been safely used as a medicinal substance for more than a hundred years. It was first listed in Squire's Companion to the British Pharma-copoeia in 1884. Subsequently, strontium was used therapeutically in the United States and Europe. As late as 1955, strontium compounds were still listed in the Dispensatory of the United States of America. For decades in the first half of the twentieth century, strontium salts were administered in dosages of 200 to 400 mg/day without toxic effects.

Strontium and Osteoporosis

Strontium tends to accumulate in bone—especially where active remodeling is taking place. In 1959, researchers at the Mayo Clinic investigated the effect of strontium in 32 individuals suffering from osteoporosis.¹

Each patient received 1.7 grams of strontium per day as strontium lactate. Eighty-four percent of the patients reported marked relief of bone pain, and the remaining 16 percent experienced moderate improvement. No significant side effects were seen, even with prolonged (up to three years) administration of strontium. X-rays taken at the beginning and end of the study showed “probable” increased bone mass in 78 percent of the cases. This is not surprising, considering the symptomatic improvement reported by the patients. Unfortunately, measurement of bone mass in 1959 was pretty crude, leading the researchers to qualify their interpretation of the X-rays. Sophisticated tests such as dual photon absorptiometry and CT scanning as used today were not available at the time this study was conducted.

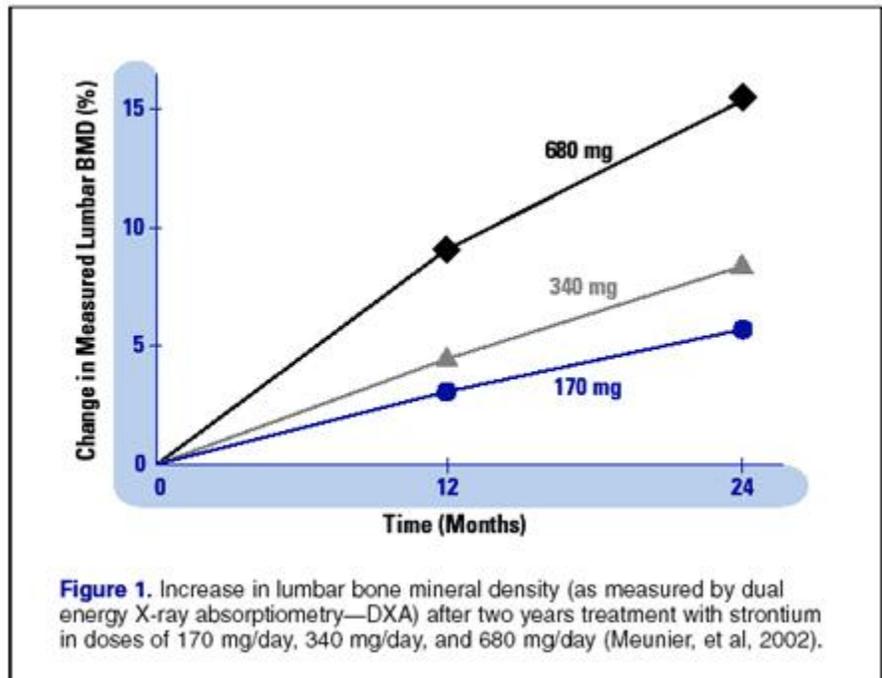
Nevertheless, because of the “strontium scare” of the 1950s, little follow-up was conducted until nearly 30 years later. In 1986, scientists administered 0.27 percent strontium to mice in their drinking water. This resulted in an increased rate of bone formation and decreased rate of bone resorption.² In another study, rats given extra strontium showed increased bone formation and greater bone density than rats fed a control diet. These reports suggested that the amount of strontium we ingest may reduce our risk of developing osteoporosis, and that strontium may play a role in the prevention of osteoporosis.⁷

In 1985, Dr. Stanley C. Skoryna of McGill University in Montreal conducted a small-scale study that pointed to a

potential role for strontium in the treatment of humans.³ Three men and three women with osteoporosis were each given 600 to 700 mg/day of strontium in the form of strontium carbonate. Bone biopsies were taken in each patient at the iliac crest (hip bone), before and after six months of treatment with strontium. Biopsy samples showed a 172 percent increase in the rate of bone formation after strontium therapy, with no change in bone resorption. The patients receiving strontium remarked that the pains in their bones had diminished and their ability to move around had improved.

Recently, interest in strontium has been rekindled by a number of studies using the strontium salt of ranelic acid (strontium ranelate). A large multi-center trial known as the strontium ranelate (SR) for treatment of osteoporosis (STRATOS) trial was designed to investigate the efficacy and safety of different doses of strontium in the treatment of postmenopausal osteoporosis.⁴

The study included 353 osteoporotic women with at least one previous vertebral fracture and low scores of lumbar bone density. Patients received placebo or strontium in doses of 170, 340 or 680 mg/day for two years. The scientists evaluated lumbar and hip bone mineral density (BMD) using dual-energy X-ray absorptiometry (DXA). They also determined the incidence of new vertebral fractures, as well as several biochemical markers of bone metabolism. Lumbar BMD increased in a dose-dependent manner as shown in Figure 1.



Also, there was a significant reduction in the number of patients with new vertebral fractures in the second year of the group receiving the 680 mg/day dose. In the 680 mg/day group, there was also a significant positive change in markers of bone metabolism. The authors concluded that the 680 mg/day dose offered the best combination of efficacy and safety, and stated without equivocation that strontium ranelate therapy increased vertebral BMD and reduced the incidence of vertebral fractures.

A much larger trial by the same research team included 1,649 osteoporotic postmenopausal women. These subjects received 2 gm/day of strontium ranelate (providing 680 mg strontium) or placebo for three years.⁵ Calcium and vitamin D supplements were also given to both groups before and during the study. In addition to suffering fewer fractures, patients in the strontium group noted a risk reduction of 49 percent in the first year of treatment and 41 percent during the three-year study period. Patients in the strontium group increased lumbar bone mineral density by an average of 14.4 percent and femoral neck BMD an average of 8.3 percent. The authors concluded that “treatment of postmenopausal osteoporosis with strontium ranelate leads to early and sustained reductions in the risk of vertebral fractures.”

Strontium and Metastatic Bone Cancer

Dr. Skoryna (1981) also tested the effect of strontium in patients with breast or prostate cancer that had spread to the bones.⁶ Metastatic bone cancer is usually a tragic condition with a poor prognosis, in which the cancer cells are multiplying out of control and gradually eat away the bone tissue. In addition to causing severe pain, metastatic bone cancer can make bones so weak that they break after only minimal trauma, or simply collapse under the body's weight. Deforming and disabling fractures may culminate in loss of mobility and intolerable pain. Metastatic cancer is difficult to treat and usually becomes progressively worse, although successful treatment of the cancer will occasionally cause the bone lesions to regress.

Notwithstanding this rather dim prognosis, Dr. Skoryna administered strontium (in the form of strontium gluconate) for at least three months. The dosage of strontium was only 274 mg/day—much lower than the 600 to 700 mg/day he

used in his osteoporosis study. However, since strontium gluconate is absorbed more efficiently than strontium carbonate, less strontium was needed to achieve the same blood level. In many cases, the results were clear-cut and dramatic. X-rays taken before and after strontium therapy demonstrated new mineral deposits in areas of bone that had been eroded by the cancer. In one patient, a vertebra that appeared to be on the verge of collapse showed extensive remineralization. Although much of this newly deposited mineral was no doubt made up of calcium crystals, the presence of strontium was clearly evident by its characteristic appearance on the X-rays. These strontium deposits were still visible on X-rays taken several months after strontium therapy had been discontinued. Many of the cancer patients reported subjective improvements and gained weight while receiving strontium.

Strontium and Cavities

Strontium also has been shown to reduce the incidence of cavities. In a 10-year study, the United States Navy Dental Service examined the teeth of about 270,000 naval recruits. Of those, only 360 were found to be completely free of cavities. Curiously, 10 percent of those 360 individuals came from a small area around Rossburg, Ohio, where the water contains unusually high concentrations of strontium. Epidemiologic studies have shown that strontium concentrations of 6 to 10 mg/liter in the water supply are associated with a reduced incidence of cavities. Administering these levels of strontium also reduced the incidence of cavities in animal studies.⁷

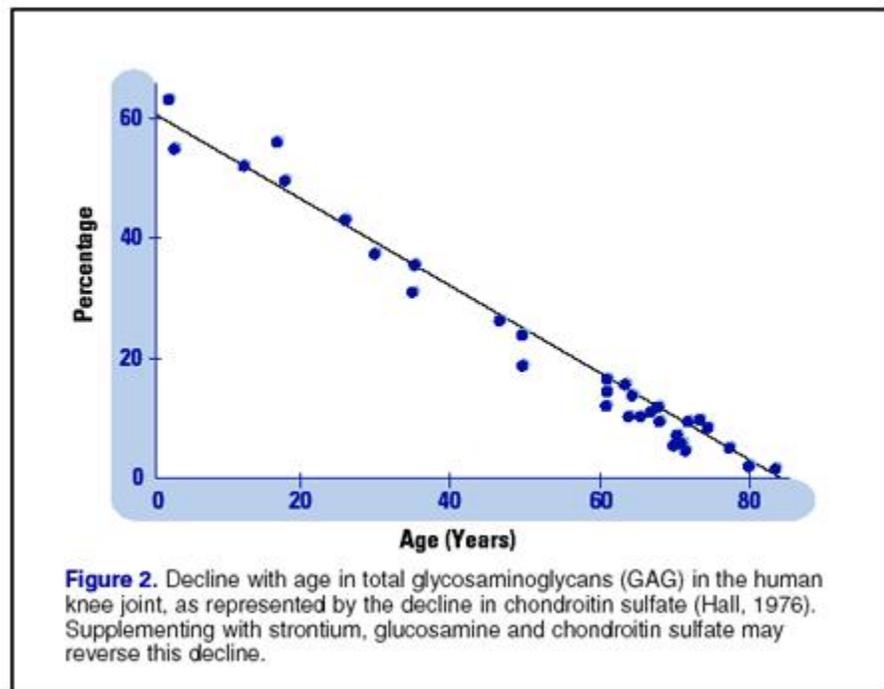
Strontium and Arthritis

Based on the studies showing that strontium improves bone density in osteoporosis, scientists at the Bone and Cartilage Metabolism Research Unit, University Hospital, Liege, Belgium, hypothesized that strontium might also improve cartilage metabolism in osteoarthritis (OA).⁸ They performed an in vitro investigation using cartilage-forming cells (chondrocytes) obtained from normal adults and patients with osteoarthritis. Chondrocytes were cultured for 24 to 72 hours with strontium, and Proteoglycan (PG) content was determined—i.e., structural components of cartilage, including hyaluronic acid, glucosamine and chondroitin sulfate. These substances—Proteoglycans, also known as Glycosaminoglycans—are known to decline dramatically with age⁹ (Fig. 2). The researchers found that strontium strongly stimulated PG production. This suggests a cartilage-growth-promoting effect of strontium, and provides a sound basis for clinical testing of strontium in osteo- and other forms of arthritis.

Conclusion

Strontium in doses up to 1.7 g/day appears to offer a safe, effective and inexpensive approach to preventing and reversing osteoporosis and may be of benefit in patients with osteoarthritis and cancer with bone metastases, as well as possibly helping to prevent dental cavities. Doses of 680 mg/day appear to be the optimum dose, although lower doses are clinically effective.

Dr. J.Y. Reginster (2002), one of the principal strontium researchers, cautions that co-administration of strontium with calcium appears to impair strontium absorption,¹⁰ so I recommend that strontium be taken on an empty stomach, and that it especially not be taken with other multi-minerals that usually include calcium.



Although the more recent studies used strontium ranelate, earlier studies used other salts of strontium, including strontium carbonate, strontium lactate, and strontium gluconate. It appears that the active ingredient is strontium, and whatever salt of strontium used is less important than the amount of strontium consumed.

Also, although the studies cited above used only strontium, plus calcium and vitamin D, I believe that even better results would be achieved by including other potential anti-osteoporotic substances such as a broad-spectrum mineral replacement that includes magnesium, vitamin K and boron, plus Xylitol, ipriflavone, calcium hydroxyapatite,

progesterone cream (and in some cases, estrogen), and DHEA. A comprehensive regimen of synergistic bone-enhancing substances should provide the optimum regimen for preventing and treating osteoporosis.

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