

MICROCRYSTALLINE HYDROXYAPATITE

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Osteoporosis is a metabolic bone disease that results in a loss of bone accelerated beyond normal “physiological” rates. Early diagnosis is difficult because osteoporosis is asymptomatic until it has advanced far enough to actually cause structural failure of the bone.

Most adults lose minerals from bone steadily throughout their life. In women, bone loss is accelerated during menopause and for two to five additional years, after which the rate of bone loss returns to its previous rate. Bone loss in untreated postmenopausal women may ultimately equal more than half of their normal bone/calcium levels.

Evidence, summarized by Menier et al (1983), suggests that osteoporosis occurs in different forms: loss of cortical bone, which leads to fractures of long bones (femur, humerus, etc.), and loss of trabecular bone, which may cause crush fractures in the spine. The diagnosis of osteoporosis is usually made when crush fractures of the spi-

nal vertebral bodies occur which consequently leads to loss of height. In studies by Riggs and co-workers (1980) on the effects of non-treatment versus calcium supplements, fluoride, estrogens or vitamin D (either alone or in combination), fracture rates in patients with postmenopausal osteoporosis were reduced by each of the active treatments except with the use of vitamin D alone and of course with non-treatment.

Calcium supplements, sodium fluoride and estrogens are the only agents with an established ability to favorably influence the process of osteoporosis: of these, only calcium is without major potential hazards and this has resulted in considerable interest in its use. Clinical trials have yielded promising results with calcium use in terms of the facilitation of fracture union and the reduction of osteoporosis resulting from: long term corticosteroid therapy (in rheumatoid patients), chronic liver disease, primary biliary cirrhosis and the alleviation of bone (spinal) pain.

TABLE 1: Risk factors associated with accelerated bone loss.

- Family history of osteoporosis.
- Lack of or inadequate exercise.
- Heavy use of tobacco or alcohol.
- Early removal of the ovaries (ophorectomy)
- Small boned and slenderness as opposed to large bones and overweight.
- Poor diet (low calcium foods, high phosphorus foods, calcium antagonists).
- Chronic use of certain drugs (steroids, diuretics and antacids containing aluminum).
- Certain disease conditions (chronic liver disease, cushings syndrome, hyperthyroidism).
- Menopause.
- Chronic stress.
- Poor digestion.
- A sedentary occupation.

Calcium, a major bone mineral, plays a vital role in many physiological processes, including blood coagulation, the sending of messages along nerves, maintenance of muscle tone, preservation of cell membrane integrity and permeability, and certain glandular functions. Most body calcium is stored in the bone: less than one percent is readily available in extracellular fluid for these important functions. Depleted levels of serum calcium may be restored by absorption of dietary calcium or, more often, by taking calcium from the bone stores. Over the long term, robbing calcium from the bones can lead to thinning, weakening and possible bone fracture.

About 10% of the population, especially women, will suffer such a fracture. Thirty percent of these will die within a year of the fracture from complications and 50% to 66% will spend the rest of their lives in a convalescent home!

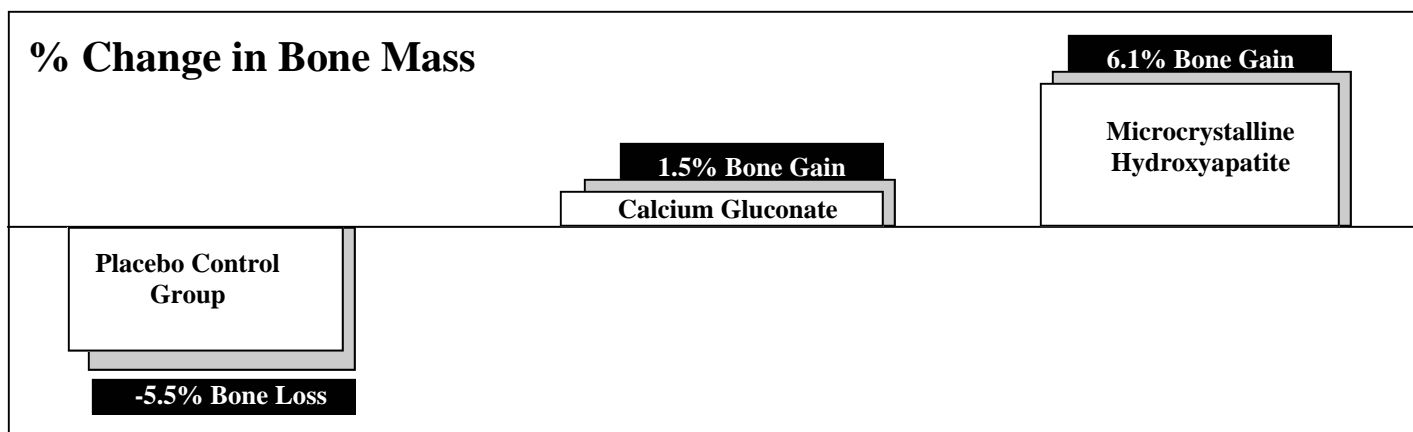
At the University of Florida, 250 women who were at risk for the loss of calcium (Osteoporosis) aged 20 to 80, were screened. 53% were found to have less than average amounts of bone, with 21% found to actually be osteoporotic.

Cheap finely powdered calcium carbonate, which is readily available, has the disadvantage of producing carbon dioxide and of interfering with digestion. Windsor and colleagues (1973) have

shown that calcium in whole bone extract, microcrystalline hydroxyapatite (MCHC), is well absorbed and does not have the disadvantages of the other calcium preparations. MCHC contains the bone minerals calcium and phosphate, together with trace amounts of magnesium and fluoride, in the normal physiological proportions. In controlled trials in groups at risk of developing osteoporosis, Nilsen and co-workers (1978) found that patients with rheumatoid arthritis having steroid treatment were protected when using microcrystalline hydroxyapatite from the usually accelerated loss of bone seen with the use of steroids.

Microcrystalline hydroxyapatite (MCHC) is a comprehensive supplement which appears to provide calcium in an extremely bioavailable form. This has been demonstrated in a number of calcium balance and calcium absorption studies, many of which have indicated the superiority of MCHC over traditional soluble calcium supplements.

MCHC is not a bone meal, nor should it be confused as one, even though it is a whole bone extract. Unlike bone meal, it is not heated in the reduction process, instead it is processed at a very low, computer-controlled temperature. Nor is it washed with chemical solvents, as is done with bone meal. From cattle and sheep raised for market on insecticide-pesticide free pastures, the long



bones are defatted and processed into the micro-crystals, retaining all the minerals they originally contained.

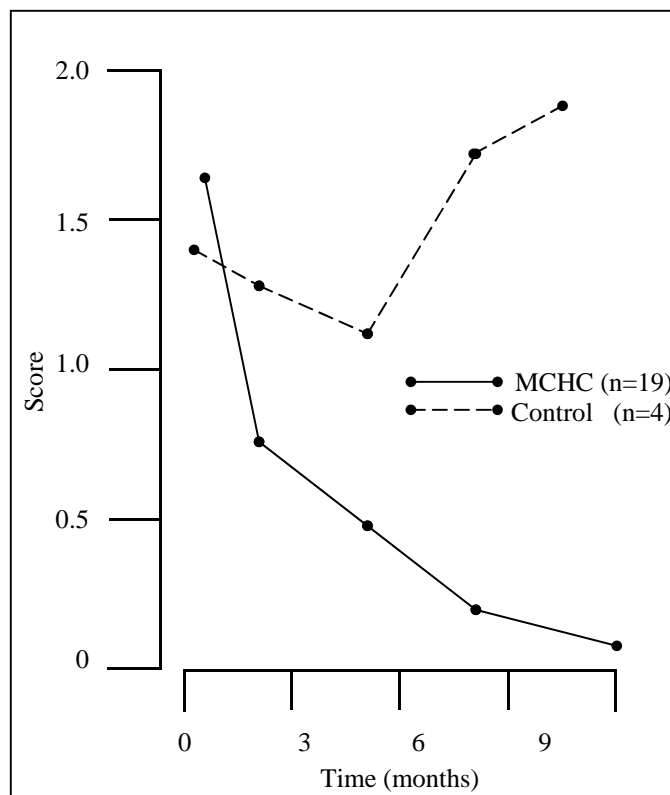
To compare its effect on accelerated cortical bone thinning, MCHC and calcium gluconate (CG) were tested on 64 randomly selected postmenopausal women with primary biliary cirrhosis. Primary biliary cirrhosis (PBC) is a chronic cholestatic liver disease that predisposes these patients to develop metabolic bone disease and premature cortical bone thinning which can be demonstrated radio-logically.

The majority of these patients are menopausal or postmenopausal and chronic cholestasis causes steatorrhea with mal-absorption of calcium, phosphate and vitamin D. Inactivity and renal tubular acidosis which also occurs in this disease may further contribute to the development of bone disease. One group of women in the study received no mineral supplements (control), one group received microcrystalline hydroxyapatite (MCHC) and one group received calcium gluconate (CG). All patients received vitamin D.

Over the course of the study, none of the groups showed a significant change in serum calcium or phosphate levels and no patient developed hypercemia, hyperphosphatemia, or elevation of serum creatinine levels. There was, however, a significant loss of cortical bone in the control group, no change in the CG group and a significant increase in the bone thickness in the MCHC group (a net cortical gain of 6.1%). The pattern of cortical bone thinning in PBC resembles the normal pattern occurring after menopause but the changes are more profound and occur prematurely. MCHC provides both organic and inorganic constituents occurring in normal bone with microcrystalline hydroxyapatite, phosphorus, trace minerals (Magnesium, Zinc, Potassium, Silica, Rubidium,

Fig 1:

Mean back pain severity scores before and during the trial period in 23 patients.



Manganese and Iron), protein as collagen, glycosaminoglycans, and amino acids. No other form of calcium has been found to be as effective, as easily absorbed and as useful in all cases of calcium deficit as microcrystalline hydroxyapatite.

A controlled trial on 40 patients at risk of osteoporosis because of long term treatment with prednisolone was undertaken to determine the efficacy and tolerance of MCHC when used to prevent the appearance or progression of osteoporosis. Two groups of patients matched for age, sex and underlying disease were tested. The majority (68%) of the patients had back pain prior to the trial. In the MCHC treated group, there was a dramatic and significant ($p < 0.001$) reduction in pain during the trial, almost to the point of its disappearance. Of the patients in the control group (which received Calcium gluconate) back pain remained the same

or increased.

There were no reports of drug related side-effects in this study; and laboratory tests on renal and hepatic function revealed no signs of toxicity. The results indicated that, with MCHC therapy, favorable biochemical and bone changes occurred with dramatic reductions in symptoms (skeletal pain).

Butterfield (1968) showed that osteoporotic patients absorbed radioactive isotope ^{47}Ca more slowly than normal subjects. In a study showing marked improvement of tracer calcium absorption with whole bone extract (MCHC) compared to calcium gluconate, it is surmised that the phosphate ration found in the MCHC was a crucial factor in determining absorption. Clark (1969) showed that in rats, dietary phosphate was necessary for optimum absorption. Goldsmith (1969), studying immobilization in 6 normal healthy volunteers, found that those which received phosphate supplements lost less calcium. MCHC also contains fluoride. Fluoride is incorporated into the skeleton as fluorapatite and this may reduce the resorption of bone. This form of fluoride has adverse effects as other supplemental forms might. Microcrystalline hydroxyapatite, therefore, provides the best bioavailable and effective means of preventing and reducing cortical bone thinning.

MCHC is the organic protein calcium matrix found in raw young bone. It provides both organic and inorganic constituents. Hydroxyapatite, as a complex crystalline compound, contains 23% calcium and small amounts of magnesium, zinc, copper, manganese, fluoride, silica, iron, rubidium and platinum. It is approximately 14% collagen protein and 4% other amino acids, primarily hydroxyproline, glycine and glutamic acid.

There is speculation as to why an essentially insoluble calcium preparation should be more readily absorbed than soluble alternatives. This is

probably the result of a number of factors. Calcium absorption is enhanced in the presence of protein or an organic matrix and the microcrystalline structure gives a large surface area from which the minerals may be released from the organic matrix into the intestine. Calcium balance studies in patients with osteogenesis imperfecta indicate that MCHC produces more prolonged positive calcium balance than soluble calcium salts. The low sodium content of MCHC also confers an additional advantage in the long term treatment of patients with cirrhosis or other diseases complicated by salt retention.

Early assessment, combined with an aggressive program of preventive therapy, can improve the bone density of even the most susceptible, according to a study recently published in the *Journal of Manipulative and Physiological Therapies*.

Nothing can restore the spinal posture to normal in those whose spines have already shrunk because of osteoporosis. But there is now good evidence to suggest that microcrystalline hydroxyapatite has a significant effect in preventing the development of osteoporosis and its bone damaging consequences, and can actually increase bone growth.

SUMMARY

Microcrystalline hydroxyapatite (MCHC) is a comprehensive supplement which appears to provide calcium in an extremely bioavailable form. This has been demonstrated in a number of calcium balance and calcium absorption studies. In rheumatoid arthritis, Nilson et al (1978) showed that microcrystalline hydroxyapatite (MCHC) reduced losses of both radial bone and vertebral system height, together with a reduction in back pain. In chronic respiratory diseases, Pines (1984) found that MCHC both reduced metacarpal bone loss and produced marked improvements in the symptomatology of his patients. The combination of MCHC

(but not sodium calcium gluconate) and vitamin D resulted in an increase in cortical bone thickness in primary biliary cirrhosis (Epstein). Galasko et al (1984) demonstrated beneficial effects on cortical bone thickness in patients with severe

idiopathic osteoporosis. Stellan (1985) found MCHC to be effective in preventing corticosteroid induced bone loss in patients with auto-immune chronic active hepatitis.

CALCIUM TYPES AND ABSORPTION CHARACTERISTICS IN ORDER OF VALUE IN HUMAN NUTRITION

<u>MICROCRYSTALLINE HYDROXYAPATITE</u>	<u>ADVANTAGES</u>	<u>DISADVANTAGES</u>
24% Ca	<ul style="list-style-type: none"> • Best absorbed calcium source • Increases cortical bone density • Arrests trabecular bone loss • Absorbed by malabsorbers • Proven by scientific studies on humans 	None
<u>CITRATE</u> 22% Ca	<ul style="list-style-type: none"> • Very well absorbed • Reduces risk to kidney stones • Absorbed by those with poor digestion 	None
<u>ASPARTATE</u> 10% Ca	<ul style="list-style-type: none"> • Well absorbed 	Expensive
<u>ASCORBATE</u> 10% Ca	<ul style="list-style-type: none"> • Well absorbed • Non-acidic Vitamin C (Neutral pH-well tolerated) 	Expensive
<u>LACTATE</u> 18% Ca	<ul style="list-style-type: none"> • Well absorbed 	May contain milk and/or yeast by-products. Source - fermentation of molasses, starch, sugar or whey with calcium carbonate
<u>AMINO ACID CHELATE</u> 20% Ca	<ul style="list-style-type: none"> • Well absorbed 	Soy sensitivity Often incorrectly made Sometimes Ca carbonate and soy bean blend is not a true chelate
<u>PHOSPHATE</u> 29% Ca	<ul style="list-style-type: none"> • Inexpensive • Antacid 	Fair absorption Possible lead content from phosphate rock
<u>CALCIUM CARBONATE</u> 40% Ca	<ul style="list-style-type: none"> • Inexpensive 	Poorly absorbed

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