Osteoporosis Protocol

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Intro

What I will do in this paper is talk about some of the factors involved in maintaining and improving bone density. I always like to go back to the physiology texts, because often the very basic information found there gives some good clues on how to approach a problem.

Guyton's *Textbook of Medical Physiology* says this about osteoporosis:

"Osteoporosis is the most common of all bone diseases in adults, especially in old age. It is different from osteomalacia and rickets because it results from diminished organic bone matrix rather than from poor bone calcification."

The organic bone matrix is like a protein scaffold that is then mineralized to form bone. The question then is why there is a deficiency in the formation of the organic bone matrix.

Protein and Protein Digestion

The usual approach to bone density issues is to see it as a lack of calcium or a lack of vitamin D. These may be factors, but prior to being able to build up bone calcium, there needs to be the *organic bone matrix* mentioned above. When calcium and other minerals accumulate in bone, it mineralizes a collagen protein scaffold. The protein scaffold requires, well, protein. Adequate protein to make this scaffold requires eating enough protein *and* the ability to digest it. One protein researcher, Donald Layman, Ph.D. went so far as to say that osteoporosis is a protein malnutrition disease.

One of the problems that increases with age is that it can become more difficult to digest protein. What can happen is that there is a decrease in the stomach's production of pepsin (an enzyme that helps break down protein) and the acid that activates the precursor to pepsin. The typical signs and symptoms that I see with this is that a larger protein meal feels heavy in the stomach, sometimes sitting there for many hours. Red meat can become especially problematic when this is an issue.

Another common symptom is excessive production of gas. The acid and pepsin that should be produced will trigger the release of enzymes from the pancreas and bile from the gall bladder. If there is a lack of acid, enzyme and bile release will be inhibited, resulting in increased gas and problems digesting your food.

So, one key piece to building that organic bone matrix is to get enough protein and to be able to digest it. If you have problems with protein digestion, that is another conversation that needs to be had.

How Much Protein Is Enough?

This is a very significant question without an easy answer. The back-story here is that we have two main fuels for our body - carbohydrates (starches and sugars) and fat. When we need carbohydrates, our body may take protein and convert it into sugar for fuel.

The problem comes when we become what I like to term “carbohydrate-dependent,” which is a situation where it is very difficult to burn fat for fuel because the insulin/blood sugar system is out of whack. Typically, after we eat, the body will burn the starches and sugars first or put them into storage for later use as either fat or glycogen.

What should happen is that when we start to run out of sugar for fuel, we should just automatically start to mobilize fat to burn. If you are carbohydrate dependent, access to fat is more or less cut off because of high insulin levels, and you will want to eat again. You will especially want to eat sugars and starches, because this is what your body can metabolize for fuel. The other thing that happens in this situation, which is pertinent for this discussion of osteoporosis, is that the body will sometimes get very good at using protein as a base for conversion into sugar.

The basics here are straightforward. If you have a blood sugar related problem - hypoglycemia, pre-diabetes, or diabetes itself, this needs to be attended to. Attending to this will decrease inflammation and decrease the need for protein, because protein is not being taken for fuel.

If you are having a blood sugar problem, then you will need much more protein because at least some of it is being taken to support the energy of your body. In this situation, you may need up to 35-40 grams of protein up to three times a day.

If you are not having a blood sugar problem, then 30-35 grams of protein two times a day may be quite adequate. If you are doing a lot of exercise, then you will need more.

In summary, if you are in this situation with blood sugar and insulin, you will need to eat more protein, not just for body repair and maintenance and structural bone building, but also to provide fuel. If you are robbing out your protein to support your need for energy, you will need a lot more protein to be adequate to provide both fuel and a source to make the organic bone matrix. If this is an issue for you, you might want to look at my *Macronutrients and Health* paper where I discuss blood sugar issues and fat burning.

Inflammation and Stress

This, along with the protein issue, is another sleeper issue not much thought about. Chronic, low-grade inflammation is associated with an increase levels of a chemical in the blood called interleukin 6, or IL6. IL6 has a very powerful effect on bone, causing it to break down much more rapidly than it ordinarily would. The problem is that if you break down bone rapidly, but there are inadequate resources to rebuild bone, there will be a net loss of bone.

Sources of chronic inflammation are many. This is something to discuss with your physician. Incidentally, one of the most common sources of chronic, low-grade inflammation is a problem with blood sugar.

If you have a chronic disease that is inflammatory, you might want to take some natural anti-inflammatories such as curcumin and fish oil, for example. Dental problems, especially gum disease and problems with old root canals are especially problematic.

Emotional stress tends to cause chronic inflammation if it is excessive or prolonged.

Autophagy

Just when you thought that protein and inflammation were the main events with osteoporosis, I am going to bring in a hopefully brief period of confusion into the mix. For those of you who have read previous versions of this paper this is the most significant revision. Some parts of this section will make recommendations that are seemingly the opposite of what I discussed in the protein section above.

My process of trying to understand the role of autophagy in human health and disease began at the very beginning of my career. I have been trying to understand what happens with osteoarthritis since the earliest days of my practice. Most of the information was pretty unsatisfying- just recommendations for one supplement or another. One doctor provided a clue when he said that people with osteoarthritis should avoid sugar. He didn't say why, but the implications will become clear in a moment. Another clue came in my reading of Jason Fung, MD's work on fasting where he reported that several of his patients with osteoarthritis had their osteoarthritic nodes reabsorb with his fasting protocols.

The most important clue came from a paper I read that looked at the way energy was made and used in the cells of the bone and cartilage that had undergone arthritic changes. The most efficient way for a cell to take sugar or fat and make the most energy is through a process called "oxidative phosphorylation". Here one unit of fat or sugar is converted into 36 units of energy. (The units are called ATP for those of you with an interest in these things.) What the researchers found is that in the cells of an arthritic joint, the metabolism had switched to a different process termed "aerobic glycolysis" which makes a mere 2 units of ATP from the same unit of fat or sugar. Glycolysis is usually only used when there isn't enough oxygen available to do oxidative phosphorylation. In the case of aerobic glycolysis, there is plenty of oxygen available, but the metabolism switches to glycolysis anyway.

What that simple observation triggered for me is a connection to several other papers I had read about what are called "senescent cells".

Stay with me here. This will make some sense in a moment.

When a cell has reached the end of its life cycle it is "tagged" or marked for removal by the body. These are the senescent cells, and the removal process is called *autophagy*. These cells are ordinarily removed *when we are short on food.* Our bodies evolved to be able to adapt to periods of food shortage or outright famine. You might think of senescent cells as a kind of "savings account" of potential raw materials to be used for repair and maintenance. Our bodies won't just throw these cells away. It breaks down these cells and uses all the parts to rebuild other cells. The problem comes in when we have a hyper abundance of food 24/7, 365 days of the year. We have far less pressure to remove these cells because the need just isn't there. The problem is that these cells don't just sit there. They are not inert. It turns out that *they actively secrete IL6- the same inflammatory substance mentioned above.*

What happened next for me was a revelation. I did a search for "senescent cells and osteoarthritis" and as expected, found that these cells were all over the joints of osteoarthritic patients. Well, I thought, what about osteoporosis? *They are highly represented in osteoporotic bone.* Next, I did a search for macular degeneration and peripheral neuropathy- more chronic degenerative diseases of aging, and again, there was good evidence of an abundance of these types of cells. It appears that an accumulation of senescent cells is a hallmark of chronic degenerative diseases.

The question then becomes how we keep the senescent cells turning over at an adequate rate to prevent or delay these chronic degenerative diseases. A clue can be found in the studies of the so-called “Blue Zones”. These are parts of the world where people have both a *long lifespan,* but also a *long health span*, the latter term referring to living a longer period of your life in relative health, free of the degenerative diseases. A book by James Clement called The Switch discusses what is in common with the people living in Blue Zones. What Clement suggests in his book is that a key feature is a calorie restricted diet. This makes a lot of sense in that fewer calories would trigger us to utilize the senescent cells for raw materials thus decreasing the local inflammatory effects of the senescent cells.

At this point you will rightly ask how this squares with what I wrote above about a lack of protein. Osteoporotic bone does show a lack of the protein matrix needed to build strong bone. The question becomes why this matrix is lacking. I don’t think that we have the answer to that as yet. The local inflammation in osteoporotic bone activates the cells in the bones that are responsible for breaking down old bone. These cells called osteoclasts are on overdrive and other cells, the osteoblasts, that are responsible for laying down new bone can’t keep up. It may be a lack of protein. It may be that the protein isn’t so much the issue after all, and that the focus should be on clearing out the senescent cells. My educated guess is that is a combination of both.

You might ask what the main driver is of a lack of autophagy. Autophagy shuts down when insulin is chronically elevated. Insulin can become chronically elevated when we eat too many carbohydrates, too much sugary food, and ironically, too much protein too often. It becomes elevated when we have fatty liver, an affliction that affects a very large proportion of the adult population in the United States. It becomes elevated when we eat too often or too much. More on this below.

What To Do About Protein

What seems imperative to me is to clear out the senescent cells. If these are not decreased the low grade, local inflammation in the bone will continue to cause a problem. The details of this are somewhat out of the scope of this paper, but some general guidelines may help. Please refer to my article “Fasting Basics” and another of my articles titled “Macronutrients and Health”.

Consider time restricted eating.

- This is where you limit your food to a shorter time period during the day, say 8-10 hours. The rest of the day have water, tea or coffee. You can do this every day or on select days of the week.

Consider a fasting mimicking diet

- What we are after here is to mimic what our ancestors regularly dealt with where there was frequent food insecurity.
- This may be the best way to clear out senescent cells. The concept of a fasting mimicking diet was developed by Valter Longo, PhD. With this approach you do the fast for 5 days once a month for 3-4 months, then quarterly after that. On the first day of the fast you take in about 1100 calories, followed by 700 calories on days 2-5. The diet is low protein, low carb and high fat. This way of eating encourages the body to search out and clear senescent cells, using them for fuel and for tissue repair and maintenance. There are numerous ways to accomplish this type of dietary plan.

Consider protein cycling.

- Protein cycling is where you have periods of time where you eat an abundance of protein cycled with periods of time where your protein intake is quite low. As with fasting, it is important to exercise on the low protein days. Clement in The Switch recommends this. He favors a seasonal cycle where you take in more protein about 3-4 months of the year. This would be tough in a northern climate where we need to stay warm. What I would recommend is a weekly or monthly cycle where you eat less protein and fewer calories generally for days or even weeks at a time followed by relative plenty where you eat more.

Control your insulin and blood sugar.

- This is a key issue. If you have an elevated insulin, you will not go into autophagy. Elevated insulin comes from high carb diets. As mentioned above, protein also triggers insulin, hence the recommendation for cycling.

Collagen.

- With bone density issues, collagen can be very helpful as it supplies the type of protein that goes into forming the protein matrix of the bone. Take several scoops of collagen peptides with a meal daily. You can put this in soups or stews, shakes, etc., or just mix it with some water and take with a meal. Take vitamin C 500mg with the meal that has collagen in it.

Nutritional Support

The best way to ensure that you have adequate levels of the various nutrients is to eat real food. Please see my papers “Diet Basics” and “Vegetarian Diet Basics” for more information.

In addition, whenever you see an article on osteoporosis, various nutrients will be mentioned. These are important *once you have adequate organic bone matrix present*. There is no current way that I am aware of knowing whether the matrix is in place or not. About all that we can do is what might be called “best practices”. Adding some of the various nutrients involved may help. What follows is some basic information on that front.

Vitamins Including A, D, K2, B12, Folate and Vitamin C

A, D and K2 Synergy

Vitamins D, A, and K2 are synergistic with each other in helping build bone and bone remodeling. When each of the nutrients is adequate, it will generally prevent any one of them from becoming toxic. When any one of them is missing, any of the others becomes more likely to become excessive. For instance, if you take high doses of vitamin A without adequate vitamins K2 and D, the A will become a problem. With adequate D and K2, you can take relatively large amounts of A with no problem at all.

Vitamin K2

Vitamin K2 is synthesized in the gut by bacteria. If you have gut issues, then you may have a problem in this area. To the best of my knowledge, no testing exists for K2. The test for “vitamin K” is for vitamin K1, which is not useful. For vitamin K2, there are various kinds available. What you want is the MK4 variant. The Life Extension Foundation has a higher strength MK4 version of K2 available which has been studied extensively in Japan in the

treatment of osteoporosis. It is called Mega K2. It is available at LEF.org or on Amazon. Take one per day.

Vitamin D

Take vitamin D 2000-5000iu per day. If you take the higher amounts, it is best to get tested to make sure that you are not getting too much. Make sure that it is D3 or cholecalciferol. You do not want D2.

Vitamin A

Vitamin A at 10,000iu per day is a good amount. Make sure that it is actual vitamin A, not "vitamin A from carotene." With actual vitamin A, you may see vitamin A from some type of cod liver oil, or you may see some type of "retinyl" in the name. An example would be retinyl palmitate.

Folate and B12

Folate and B12 are critical for new bone formation and are not uncommon deficiencies as we age. Folate as 5MTHF or 5 methyltetrahydrofolate (rather than as folic acid, a synthetic folate variant), and B12 as methylcobalamin is available. Klaire Labs one called Active B12 Folate. This is available through the Fullscript app. A link to this app can be found at the bottom of my website, richardhruby.com.

Vitamin C

Vitamin C is critical in helping the organic bone matrix to form. It helps form collagen, the backbone of the matrix of bone.

Mineral Nutrients

Calcium

Calcium as calcium citrate or a microcrystalline hydroxyapatite are the easiest to absorb. I typically don't recommend any more that about 300-600mg of calcium per day. Avoid calcium carbonate as it is very hard to absorb. Coral calcium is a type of calcium carbonate. Always take calcium at a separate time from any other minerals. Calcium will be preferentially absorbed, crowding out the other minerals when taken at the same time.

Magnesium

Magnesium deficiency is a very significant contributor to problems with poor bone density and poor bone quality. Magnesium appears to contribute to the flexibility of bones when they are formed. Since most people are low in magnesium because of soil depletion, it is not necessary to test this in most cases. Here I would recommend 400-600mg per day taken at a separate time from calcium. For instance, take the calcium or the magnesium at bedtime, and the other one in the AM. See if one way or the other helps your sleep. Too much magnesium at once will cause loose stools or general gut unease. If you have trouble with any magnesium, you might try the liquid magnesium chloride, mixing the equivalent of 400-600mg with water and sipping it through the day. A less expensive option is to get magnesium chloride powder and mix 400-600mg with water, again, sipping it through the day. Magnesium chloride taken as a liquid is more palatable if you add a bit of lemon juice to the water.

Boron, Silicon and Zinc

Boron has been shown to decrease the release of calcium and magnesium into the urine. It also has some effect on maintaining more natural hormone levels in the body. This may be

how it helps maintain bone density. Silicon is very helpful in the formation of organic bone matrix. You can take Biosil, a type of bioavailable silicon, 6 mg per day. This must be taken away from both calcium and magnesium. Make sure that you are sufficient in zinc. Zinc is commonly in short supply, again from soil depletion. A small amount of zinc can be very helpful. I would recommend that you take 15-30 mg per day on average. You can take more but it is important to not overdo it. It would be good to work with the advice of a practitioner who has knowledge of nutrition when supplementing specific nutrients.

Sometimes you will hear about strontium being used. I would not recommend it. Strontium is very similar to calcium. If you flood your system with strontium, you will have some increase in bone density, but the body will rid itself of the strontium as fast as possible once there is adequate calcium to take its place.

Exercise

Exercise is a critical component of bone building. You might think of it this way. The body is pretty smart. It won't spend its money making strong bones if there is no particular reason to. Exercise stresses the bones. When bones are put under stress, the body responds by laying down more bone to handle the stress. The more the stress, the more the bone builds up, assuming that there are enough raw materials to do so.

Exercise can and should take many forms. Strength training, stretching, yoga, walking, dancing, bouncing on a mini trampoline, jumping rope, even isometrics - anything that requires you to put stress on your body (and bones) will tell the body that strength in the bones is needed.

Mix up strength training, stretching, walking, dancing, etc. Pick things that you will actually do, that are at least tolerable, if not fun. As one person put it, *the best form of exercise is the one that you will do.*

Hormones

Both estrogen and testosterone play a role in bone building and maintenance. A significant amount of bone is lost in women at menopause because of the lack of adequate estrogen. Estrogens tend to keep the cells in the body that break down bone for remodeling under tighter control.

It is especially important at perimenopause and menopause to get adequate exercise and to have good nutrition. It may be appropriate to supplement with some bio-identical hormones if you and your doctor feel that this is appropriate for you. By and large if you are some years into menopause, adding in hormones will not be of as much help.

In men, adequate testosterone has a similar role as estrogens do in women.

Medications

The bulk of the medications that are used for osteopenia and osteoporosis tend to stop the body from breaking down and remodeling bone. What should happen in a healthy situation is that the cells in the body that are responsible for initiating the remodeling of bone, the *osteoclasts*, begin the process by dissolving bone, literally making tiny tunnels in the bone matrix. New matrix is then laid down in these little tunnels and bone is rebuilt by *osteoblasts*.

These drugs block the osteoclasts from working. If the osteoclasts don't work, then osteoblasts can't create new, strong and healthy bone.

What most of the medications do is to prevent the osteoclasts from breaking down bone. Fewer tunnels and less remodeling are the result. You will see some increase in bone density with this approach, or at least a stabilization of bone density. The problem is that you end up with large quantities of poor-quality bone. After some years of this, if the bone breaks it doesn't tend to break normally at all. It tends to shatter. I cannot recommend these medications except as a short-term stopgap with severe osteoporosis, in which case it may be useful for a time as you put other measures into place.

Summary

One of the difficulties with being treated for bone density issues is that it is not possible to get good feedback on how your efforts are affecting your bones on a day-to-day basis. Bone density tests are typically not done more than once a year. There are no other commonly used markers for bone loss or for bone rebuilding, so we are left to try something for a year and see what happens. This is obviously not very satisfying.

This paper is my best effort to describe some plausible reasons for bone density issues and to outline some possible fixes. At the very least, these recommendations will not hurt you. They may well help, but you will have to wait for a year or more to know. What you can do is use other markers of health and wellbeing as indicators. Most people feel better when they adjust their diets in order to manage insulin and blood sugar. Getting quality nutrition is frequently marked by better energy and better sleep as well as by more clarity of mind and a sense of wellbeing.

It takes many years to develop bone density issues. Relax a bit. Figure out a plan and work with it. Pay attention to the general signals of improved wellbeing and use those as your markers of progress.