While watching the 2008 Olympics recently, did you wonder what those world-class athletes were eating? How many of them had nutrition consultants advising them on calories, macronutrients, micronutrients, and — most importantly — phytonutrients to help them recover from the strenuous training and the all-out effort they put in day after day? Furthermore, how will the young athletes who are not savvy about nutrition age? Will they fall prey to premature burnout, which is common in competitive sports? Will they resort to performance-enhancing drugs rather than stabilizing and tonifying nutrients in order to stay in the game?

Just as top-tier athletes need trainers, coaches, psychologists, and health advisors, so too does the weekend athlete, who trains intermittently and may be unaware of the toll that strenuous exercise can cause when the diet is poor or erratic. Clinical nutrition consultants are very much in demand to provide nutrition services to these ordinary athletes, evaluating their unique nutrition and metabolic status to see if they are receiving the optimal diet, booster foods, beverages, and supplemental nutrients that will help them perform at their best and prevent minor or major injuries and endocrine exhaustion due to inadequate or excessive calories and nutrients.

Most people are by now familiar with the increasing levels of overweight, obesity, and degenerative conditions we face in this country. The rapid rise of these conditions is a topic that has received much attention and a lot of research dollars. The conclusions drawn in countless studies lay the blame on the over-consumption of nutrient-depleted junk foods and our increasingly sedentary lifestyles, mostly spent in our cars or in front of computer or television screens.
Most people understand that regular, almost daily exercise is a vital component of good health in general and crucial for any successful weight loss program. A very recent study (Jakicic et al., 2008) found that people who were able to maintain a weight loss of 10% over the course of two years exercised at least an hour a day, five days a week, in addition to restricting caloric intake. Combining modest calorie restriction with aerobics, flexibility exercises, and strength training is now considered the most efficient way to lose fat — not just weight — and keep it off. Another study that looked at lifelong runners (Chakravarty et al., 2008) found that people who practice long-term aerobic exercise experience fewer disabilities, a longer span of active life, and a smaller chance of dying an early death than the general population. In other words, people who exercise are healthier than those who do not.

The human body is designed to move and operates much more efficiently when given a regular opportunity to do so. Exercise boosts our metabolic rates, helps our bodies excrete toxins, is beneficial to all of our organs and blood vessels, and improves immune function. Furthermore, it benefits our minds and our moods, and — if done correctly — makes us glow from the inside out.

Moving Right Along

The human musculo-skeletal system is a compilation of organs that allows us to move. It is comprised of bones, joints, muscles, tendons, and other connective tissues (including ligaments, collagen, and glycosaminoglycans [proteoglycans]), all of which are either positively or adversely affected during exercise.

As any athletic person knows, one bad injury can ruin more than just a whole day. It can seriously disrupt a beneficial workout program for weeks or months, and sometimes much longer. For the nutrition consultant, then, the issue becomes how to provide newly active clients with the proper diet and lifestyle recommendations to help
Eating to Win: Diet & Nutrition for Athletic Injury Prevention & Treatment

them prevent injuries, thereby encouraging them to make frequent exercise a regular part of their health-promoting routines, and how to help already active clients remain so. The key factor is prevention. While the body has an enormous capacity for healing, injuries are often the "gifts that keep on giving." It is rare, following injury, for the body to fully regain its pre-injury status.

If injuries do occur, our understanding of how proper nutrition can provide excellent natural symptom relief and help rebuild tissue becomes invaluable. Remember, nutrition can be used effectively in conjunction with standard therapies, which generally consist of RICE (Rest, Ice, Compression, Elevation), non-steroidal anti-inflammatory drugs (NSAIDs), and corticosteroid drugs. While such drugs can be damaging and often actually impede the healing process, diet and supplemental nutrients can speed the healing process despite these hindrances (Bucci, 1995).

It is naive to assume that supplemental nutrients can return injured tissues to normal function, or beyond, as some would hope. Though many nutrients play a role in both injury prevention and treatment, to throw pills and potions at injuries without considering diet is to miss the big picture. It is also a waste of money. Added vitamins, minerals, and other nutrients are simply not particularly effective in the face of inadequate overall nutrition.

Nutrition for Injury Prevention and Healing

Athletic injury prevention depends on many factors. Genetics plays a role, as do training frequency and intensity, proper body mechanics, cross-training to avoid repetitive-use injuries, and adequate rest and relaxation. But the musculoskeletal system’s tissues are also profoundly affected by what we eat — including the macronutrients (protein, fats, and carbohydrates) and micronutrients (vitamins, minerals, phyto (plant) nutrients). Our dietary habits over the course of a lifetime contribute greatly to the body’s ability to perform well. Clearly, optimal nutrition takes its place among all of these variables as a vital component for both preventing and resolving athletic injuries.

The basic approach to optimal sports nutrition is to provide a wide array of nutrient-dense whole foods to support musculoskeletal health (see Eating For Health™ chart on page 4), including:

- Adequate protein intake for muscle maintenance, growth and repair, good immune function, and hormone production;
- High-quality fats for energy and reduction of inflammation;
- Good quality carbohydrates for immediate energy, stable blood sugar and insulin levels, and to aid with the protein synthesis recovery process (Virgin, 2006);
- High levels of antioxidant nutrients to help prevent lipid peroxidation and muscular damage from free-radical activity generated by exercise;
- Adequate hydration with pure filtered water and diluted fresh juices;
- A whole foods powder such as Bauman Nutrition’s Vital Scoop™ (whey, flax, greens, and fruit extract) in smoothies as a meal or snack, or combined with honey, royal jelly, and adaptogenic herbs as a calorie and energy booster when on the go.

When healing from musculoskeletal injuries, it is important to consider additional factors:

- Maintaining caloric intake — approximately 35 kcal/kg/day (Bucci, 1995, p. 216) — depending on age and level of activity (while caloric depletion can be a detriment to healing, no extra calories beyond those in the normal diet are needed unless an injury is serious enough to cause hospitalization [Bucci, 1995, p. 26]);
- Increasing nutrient density even further because athletic injuries increase requirements for various nutrients; and
- Adding specific foods, herbs, and supplements that can address the symptoms and underlying conditions associated with injuries.
Eating 4 Health

A Rejuvenating Food System
© by Edward Bauman, Ph.D.

Organic, Seasonal, Nutrient-rich, and Individualized

<table>
<thead>
<tr>
<th>SEEDS/OILS</th>
<th>PROTEIN</th>
<th>LEAFY VEGETABLES</th>
<th>CRUNCHY VEGETABLES</th>
<th>UNREFINED STARCHES</th>
<th>SEASONAL FRUIT</th>
<th>BOOSTER FOODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Servings</td>
<td>2-3</td>
<td>2-4</td>
<td>1-3</td>
<td>1-3</td>
<td>2-4</td>
<td>2-4</td>
</tr>
<tr>
<td>Serving Size</td>
<td>1 Tbsp. oil</td>
<td>2 Tbsp. seeds</td>
<td>3 oz. animal</td>
<td>1 cup</td>
<td>1/2 cup</td>
<td>1/2 cup root vegetable, grains, bread.</td>
</tr>
</tbody>
</table>
Dietary Recommendations for Musculo-Skeletal Health and Injury Prevention:

General:
- Eat 3 meals and 0–2 snacks each day, ensuring that you eat every 4–6 hours (Virgin, 2006) to ensure stable blood sugar and insulin levels. This will also help keep cortisol levels regulated, which is crucial, since chronic high cortisol will cause the breakdown of muscle tissue and can lead to adrenal fatigue, a condition that can lead to heightened susceptibility to musculoskeletal injury and a decreased ability to heal (Barker, 2006).
- Keep well-hydrated overall with plenty of filtered water (about 64 oz. daily). When exercising, extra hydration is important. Both fluid and fuel needs spike 30–40 minutes into a strenuous workout, and the best way to satisfy these requirements is to provide your body with carbohydrates and protein in a liquid form (Barker, 2006). Drinking 8 ounces of water mixed with 1 1/2 to 2 ounces of orange juice plus one serving of a high-quality whey, rice, or hemp protein powder, will provide the recommended 6–8% carbohydrates and one serving of protein. Commercial sports drinks contain the right percentage of carbohydrate, but they also contain refined sugars and other additives and represent a less-than-optimal choice.
- **Protein:** Eat the following amounts of high-quality proteins, such as cold-water fish, organic poultry, grass-fed meats, organic soy products such as tempeh and tofu, and high-quality whey protein powder:
  - 1.0–1.5 g/kg/day (70–100 gm protein daily for a 70-kg. (150-lb.) person) (Bucci, 1995, p. 216).
  - Divide this protein between all meals and snacks to ensure optimal assimilation (Virgin, 2006).
- **Good fats,** such as those found in cold-water fish; nuts and seeds such as walnuts, flax, and pumpkin seeds (which also provide some protein); avocado and coconut; extra virgin olive oil; and small amounts of organic butter.
- **Fresh organic vegetables and fruits;** eat at least 5 servings daily, preferably more.
- **Whole grains, beans, and legumes**
- **Antioxidants:** Studies concur that exercise produces reactive oxygen species, leading to free radical activity and possible damage to lipids and muscles (Clarkson et al., 2000; Sen et al., 2000; Evans, 2000). This effect is most pronounced in people who do little training, or in older people and those with impaired antioxidant status (Evans, 2000). Though regular exercise reduces this problem, extra antioxidant protection is an important dietary component for the health of connective tissue. Research into antioxidant supplementation has shown inconsistent, sometimes disappointing, results (Clarkson et al., 2000; Hamilton, n.d.), possibly because studies have focused on the effects of single nutrient supplementation, usually with vitamins C and E, selenium, and lipoic acid, along with measurements of glutathione activity. Eating foods high in antioxidants skirts the issues associated with supplements.
  Antioxidant-rich fruits and vegetables also contain good amounts of carotenoids and bioflavonoids. Carotenoids are precursors of vitamin A, which is critical for bone and connective tissue health, fast wound healing, and good immune function (Bucci, 1995, pp. 64–65). They are most abundant in red, yellow, and orange fruits and vegetables and in leafy greens. Bioflavonoids protect connective tissue and reduce the production of enzymes that promote inflammation (Percival, 2002).
Antioxidant Foods (from www.whfoods.com)

<table>
<thead>
<tr>
<th>VITAMIN C FOODS</th>
<th>VITAMIN E FOODS</th>
<th>LIPOIC ACID FOODS</th>
<th>GLUTATHIONE-GENERATING FOODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papaya, red bell peppers, Brussels sprouts, strawberries, oranges, cantaloupe, kiwi, cauliflower, kale</td>
<td>Nuts and seeds (esp. sunflower seeds and almonds), mustard greens, turnip greens, chard</td>
<td>Green plants, esp. leafy greens; muscle and organ meats. (Lipoic acid regenerates vitamins C and E and raises glutathione levels.)</td>
<td>Cysteine-containing foods: poultry, yogurt, egg yolks, red peppers, garlic, onions, broccoli, Brussels sprouts, oats, and wheat germ</td>
</tr>
</tbody>
</table>

Selenium-containing foods: Brazil nuts, crimini mushrooms, fish (cod, halibut, snapper, tuna, salmon); high-quality whey protein

Carotenoid Foods
- Apricot
- Limes
- Yams
- Cantaloupe
- Lemons
- Winter squash
- Oranges
- Carrots
- Sweet potato
- Tomato
- Kale
- Spinach

Bioflavonoid Foods
- Citrus (lemons, grapefruits, oranges)
- Apricots
- Cherries
- Berries of all types, especially dark ones
- Green tea
- Tomatoes
- Buckwheat
- Green peppers
- Greens
- Cherries
- Red grapes (and wine)
- Broccoli

If the message is not already abundantly clear, then the advice of naturopath and sports medicine specialist Dr. Jason E. Barker should make it so: **Consume an anti-inflammatory diet. Eat more plants.**

**Iron-rich foods** if ferritin (the storage form of iron) levels are low. It is somewhat ironic that while excess iron can cause oxidative damage — rust — in the body, low iron stores appear to be related to an increased incidence of athletic injuries (Bledsoe, n.d.). Considering that iron is a key component of hemoglobin, which carries oxygen in the blood, and of myoglobin, which carries oxygen in the muscles, it makes sense that low levels could lead to injury. But because iron supplementation can lead to overload, it may be wiser to eat more iron-containing foods, such as:
- Spinach
- Chard
- Cooked dried beans
- Parsley
- Thyme
- Fish
- Poultry
- Eggs
- Muscle meats
- Calf’s liver
Booster Foods:
- Sea vegetables and algae
- Whey protein powder
- Flax seed
- Nutritional yeast, a good source of B vitamins, vital to injury recovery
- Herbs and spices, both fresh and dried, many of which have anti-inflammatory properties

A diet supporting musculo-skeletal health minimizes the following foods:
- Excess caffeine;
- Refined carbohydrates such as white flour products; sugar- and fructose-sweetened foods;
- Artificial sweeteners;
- Fried foods, greasy foods; and bad fats — including margarine, partially hydrogenated fats, large amounts of vegetable oils, and excess fat in general;
- Processed foods and snacks of all kinds, including luncheon meats, chips, cookies, crackers, cereals, and pastries;
- Smoking;
- Alcoholic drinks; and
- Over-the-counter drugs.

Athletic Injuries
The musculo-skeletal system can sustain injury in several ways:
- **Sprains and strains** are some of the most commonly seen athletic injuries. Sprains result from an injury to a ligament, the connective tissue that links bones together at joints.
- They most often occur in the ankle, knee, elbow, or wrist. Strains occur from tears in muscle tissue and are often seen in the muscles that support the neck, thigh, groin, and ankle. They are most likely to occur when muscles are asked to both stretch and bear weight simultaneously, with the weakest part of the muscle not having the strength to bear the load (OneMedicine, 2001).
- Symptoms include pain and swelling, with a possibility of joint instability if the injury is very severe.
- **Tendinitis and Bursitis** can be very painful injuries that limit activity for long periods of time. Muscles are attached to bones by connective tissue known as tendons. When a tendon is inflamed from repetitive or excessive exercise, or from an acute injury, tendonitis results. It occurs most commonly around the shoulders, elbows, wrists, and heels. Bursitis occurs for the same reasons and most commonly in the same places, but it is an inflammation of bursae, small fluid-filled sacs that cushion pressure points between the bones as well as the tendons and muscles near the joints.
Symptoms of both include pain — sharp or dull — and tenderness around affected joints, worsening with use or movement. Warmth and swelling may be apparent. Tendonitis can also cause numbness or tingling (HerbalRemedies, 2007; MayoClinic, 2008).

- **Broken Bones**
- **Bruises**

**Healing**

The healing of athletic injuries is divided into the following three phases, each of them dependent on the interactions of all of the body's systems — nervous, immune, endocrine, cardiovascular, visceral, and muscle (from Bucci, 1995, pp. 15–16):

- The *inflammatory phase*, which generally last 7 days, though individual cases vary. Its classic signs include localized redness, swelling, pain, and heat. Loss of function sometimes occurs. Inflammatory chemicals called eicosanoids contribute to the initiation and progress of inflammation, while other chemicals and processes work to limit it.

- The *repair phase* begins approximately 48 hours after the initial injury. It is characterized by cell growth and the production of extracellular matrix, which includes collagen and proteoglycans (protein/sugar chains, a major component of connective tissue). This phase generally lasts 6–8 weeks but can take much longer in serious injuries.

- The *remodeling phase* is initiated approximately 14 days after injury. The functions that make repair possible begin to decline, collagen synthesis and function return to near normal, and scar tissue is formed, which is usually not as strong as the original tissue. Remodeling can take up to a year or longer to be completed.

The goals for diet and nutrient supplementation for athletic injuries include relieving pain and modulating inflammation (hopefully sufficiently to reduce use of prescription or *over-the-counter* (OTC) drugs) and providing the nutrients necessary for connective tissue healing. Reducing inflammation can help prevent injuries from becoming chronic, can get people up and moving more quickly, and is thought to help speed the healing process (Barker, d, 2006; Bucci, 1995, p. 17). However, some amount of inflammation is required to promote the repair stage of inflammation, so removing it from the equation entirely can delay the healing process (Bucci, 1995, p. 17).

Virtually all of the nutrients we derive from food play a role in musculoskeletal health and to list every nutrient and its effect is beyond the scope of this article. However, research and clinical experience point to superior results for several foods, nutrients, and herbs that can relieve pain and inflammation and help the healing process. Those that have proven themselves most effective will be discussed here.

As mentioned previously, acute and chronic connective tissue injuries increase the need for various nutrients, with specifics varying by individual. Therefore, in addition to a healthful diet, many practitioners advocate the use of a high-quality multiple vitamin and mineral supplement, additional Omega 3 fats, and a synergistic antioxidant complex (Virgin, 2006; Barker, interview, Aug. 2008; Bucci, 1995, p. 218) during the healing process.

**Test, Don’t Guess: Laboratory Assessments**

All dosage recommendations are suggestions rather than prescriptions, as individual needs vary. It is strongly recommended that clients with chronic pain and inflammation, such as arthritis, bursitis, tendonitis, etc., complete the following assessments to identify their unique areas of nutritional insufficiency. This allows the practitioner to create a baseline of analysis and work up a targeted program of support. Useful laboratory tests include:
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- **A Complete Blood Chemistry (CBC) Panel** that includes tests for magnesium, vitamin D, vitamin B-12, folic acid, and homocysteine (a key cardiovascular risk factor).
- **Functional Intracellular Analysis** (by Spectra Cell Labs) to test vitamin A, B complex, D, minerals, calcium, magnesium, zinc, chromium, and copper; antioxidants such as coenzyme Q-10; and cardiovascular protective factors not included in a CBC.
- **Organic Acid Panel** to identify metabolites that indicate an insufficiency of vitamins, minerals, and amino acids needed for cellular energy production, proper neurotransmitter balance, proper pH, and gastrointestinal health. A comprehensive metabolic profile would add fatty acid and food sensitivity testing to the organic acids to provide more data on energy-depleting foods or the need for modifying the amount and ratio of anti-inflammatory essential fatty acids.
- **Hormone Assessment** to evaluate adrenal, thyroid, pancreas, and pituitary status. Athletes typically show adrenal stress, leading to fatigue that lowers thyroid function and leads to blood sugar imbalances that create carbohydrate cravings, slow recovery from exercise, and delay wound healing.

**Modulating Inflammation, Reducing Pain, and Promoting Healing**

- According to Dr. Barker, *proteolytic enzymes* (proteases) are the tools of choice for combating acute inflammation from injuries and bruises and for sore muscles (interview, Aug. 2008). They are beneficial for sprains, strains, and fractures and may also work well on chronic conditions, such as tendonitis, bursitis, and chronic joint conditions. Proteolytic enzymes digest proteins. When taken 30 minutes before meals, they go to work on the protein-containing chemicals of inflammation. They both substitute for and activate endogenous proteases. Bromelain, obtained from pineapple stems, is probably the most-studied of these enzymes and may be as effective as NSAIDs for easing pain and inflammation (DeBusk, et al., 2002). Other widely-used proteases include papain, trypsin, chymotrypsin, and pancreatin. Alone or in combination, these enzymes appear to speed recovery, sometimes by as much as twofold (Percival, 2002). Proteolytic enzymes are most effective when supplementation begins immediately after injury (Bucci, 1995, p. 179), and they can even be taken prophylactically an hour or two before an activity that may cause injury (Bucci, 1995, p. 174).

Animal research has indicated that combinations of enzymes are more effective than the use of a single protease, and using plant enzymes in conjunction with those of animal origin may provide a wider spectrum of action (Bucci, 1995, p. 174). Plant enzyme combinations alone are fine for those who are opposed to using animal products.

Dosage recommendations with proteases can be confusing, since individual enzyme measurements are reported in several different types of digestive units. Having a practitioner transpose these units into milligrams (mg) of purified enzyme, or working with a practitioner who uses products with known efficacy would be helpful for most people. Bucci (1995, p. 218) recommends proteases in these doses:
Jason E. Barker, N.D. continues usage until symptoms disappear (interview, Aug. 2008), though other researchers’ (DeBusk et al., 2002; Bucci, 1995, p. 218) recommendations range from 3 days to no longer than 10 days in a row. Possible side effects from bromelain include nausea, vomiting, diarrhea, and excessive menstrual bleeding (DeBusk et al., 2002), though most people will only experience a warm sensation in their stomachs, if anything (Barker, d., 2006).

Magnesium is a good muscle relaxant and pain killer. According to Dr. Jason Barker, magnesium can provide wonderful relief in just a few days for people with tight, stiff, or spasming muscles (June, 2008). He says that all of his athletic patients eventually take some magnesium, primarily because the medical and natural foods industries have promoted calcium supplementation so energetically for so long that almost everyone is magnesium deficient (June, 2008; interview, Aug. 2008). Couple this with the multiple mineral deficiencies in commercial farmland and it’s easy to believe that most of us are low in magnesium. However, as with most minerals, testing for deficiencies is difficult, so perhaps the best means for determination is by doing a course of supplementation and noting any beneficial results.

Dr. Barker’s recommendations are for 800 mg daily of magnesium, in the glycinate form to promote assimilation and prevent diarrhea, in divided doses (interview, Aug. 2008). Bathing in Epsom salts (magnesium sulfate) may also prove helpful. It may be best to consider high-dose supplementation as a short-term (less than one year) program, as there is speculation that high levels of one nutrient can produce imbalances in others.

Protein/Amino Acids* — Adequate protein is vital to the healing process. More than the basic recommendations, however, is not better, as extra protein has not been shown to enhance healing (Bucci, 1995, p. 30). Certain individual amino acids, though, have been shown to positively impact recovery. Notable among them are:

- **L-Glutamine**, found in abundance in low-temperature processed whey protein powders or capsules, helps repair connective tissue and is essential for synthesis of cell components such as proteins, proteoglycans, DNA, RNA, and other amino acids. It prevents immunosuppression after stress or surgery; increases the removal of ammonia waste from the body; prevents or reduces metabolic catabolism after
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physiological stress; and enhances protein synthesis and nitrogen retention after stress (Bucci, 1995, p. 38). The recommended effective dose is 1.5 gm/day.

- **Tryptophan/5-Hydroxytryptophan (5HTP)** reduces musculoskeletal pain and increases the pain threshold by building serotonin levels. Increased brain levels of this neurotransmitter are associated with an analgesic effect (Bucci, 1995, p. 44–45). Because there have been problems associated with tryptophan, making it less available today, only dosing parameters for its metabolite, 5-HTP, will be given:
  - 300–600 mg daily, in three divided doses (Bucci, 1995, p. 45)

- **D-Phenylalanine** helps relieve chronic pain from musculoskeletal conditions, such as degenerative joint issues, or from injuries. Bucci (1995, p. 47) recommends 1500 mg daily in three divided doses.

- **Arginine** (as L-arginine hydrochloride or arginine aspartate) appears to enhance healing by increasing vasodilation and oxygen and nutrient supply at the sites of injuries and wounds (Bucci, 1995, p. 36). Alone, or in conjunction with either L-lysine or L-ornithine, it releases anabolic hormones, including insulin, that speed healing and reduce body fat (Bucci, 1995, p. 36). It has been shown to boost collagen deposition and to increase protein synthesis, both markers of improved healing status (Bledsoe, n.d.).
  
  Bucci’s dosage recommendations are 10–30 gm daily of either form in 3–4 divided doses (1995, p. 47).

- **Sulphydryl Amino Acids** (methionine, cysteine and others) provide a source of sulphur for the body that is necessary for synthesis of glycosaminoglycans and collagen, as well as for optimal detoxification capability. Cysteine is a direct precursor to glutathione, the antioxidant in greatest quantity in the body; all sulphur-containing amino acids have antioxidant properties. For the purposes of athletic injuries, three forms of sulphur-aminos are used:
  - **S-adenosyl methionine** (SAMe), which has been shown to have both anti-inflammatory and analgesic properties (Bucci, 1995, p. 41). Human research trials have focused on its use for osteoarthritis, which has shown an analgesic effect equal to NSAIDs without the gastric side effects. SAMe is synthesized in the body from methionine, with help from folate and vitamin B12, and diets with adequate protein should provide enough sulphur substrate. However, supplemental doses of up to 400 mg, twice daily, for 30 days have been very beneficial for osteoarthritis sufferers (Bucci, 1995, p. 41). SAMe is recommended for use in chronic injuries, such as bursitis and tendonitis, and also possibly for sprains and tendon and ligament repair, in doses ranging from 1200–2400 mg daily in 3 divided doses (Bucci, 1995, p. 47).
  
  - **Dimethyl sulfoxide** (DMSO) is used topically in cream form as an analgesic for bursitis, tendonitis, and sprains and has been widely touted as being effective. However, some of the positive research studies on it are not considered to have been rigorous and other studies have contradicted their findings (DeBusk et al., 2002).
Methylsulfonylmethane (MSM) is a metabolite of DMSO and its oral counterpart. At doses of 100–750 mg/day, it has been shown to have benefit for inflammatory conditions, but whether it aids connective tissue healing is uncertain (Bucci, 1995, p. 42). Ameye et al. (2006) have found moderate evidence of efficacy for MSM, and studies have shown MSM and DMSO to soften collagen. MSM has also been shown to provide pain relief, dilate blood vessels, increase blood flow, reduce muscle spasms, and promote normal immune function.

Obtaining sufficient sulphur from food rather than supplements is highly recommended. Good sources include eggs, meat, fish, poultry, and legumes, as well as garlic, onions, Brussels sprouts, asparagus, kale, and wheat germ.

Recommended doses of supplements are:

- 500–1000 mg MSM daily (Hahn, 2005), or topical doses of 60-90% DMSO applied 1-3 times per day (DeBusk et al., 2002).

Because branched-chain amino acids are heavily promoted, it bears mentioning here that their effect on healing connective tissue injuries is equivocal at best (Bledsoe, n.d.), so their use is not recommended (Bucci, 1995, p. 41).

Essential Fats, the Omega 3s — alpha-linolenic acid (ALA), docosahexanoic acid (DHA), and eicosapentanoic acid (EPA) — and the anti-inflammatory Omega 6, gamma-linolenic acid (GLA), are essential for the formation of anti-inflammatory eicosanoids. Addition of these at the time of acute injury, however, is not effective, since they require some time to take effect. They are very useful, though, for chronic injuries, such as bursitis and tendinitis (Bucci, 1995, p. 59; Percival, 2002). Bucci (1995, p. 60) recommends 3–18 gm of supplemented fish oils, in addition to dietary Omega-3s, along with additional GLA.

Glycosaminoglycans (glucosamine and chondroitin sulfates) have been much studied and amply written about in the medical literature. Glucosamine is an amino sugar found in connective tissue that appears to help repair and form cartilage. Chondroitin is derived from the cartilage of various animals, often sharks, and is part of the molecule that gives cartilage its elasticity.

According to Bucci (1995, p. 201), glucosamine salts, which are mostly used to treat osteoarthritis (OA), are the most effective of all the nutrients used for musculoskeletal health. Most of the research, then, has focused on OA, but because numerous studies have shown it to be as effective for pain and inflammation as ibuprofen (Sutter, 2000; Bland, 2004), it is logical to extend its use to other conditions of degenerative joints, such as bursitis and tendinitis. It is also possible that it will be effective for tendon and ligament tears and sprains (Bucci, 1995, p. 203). As well as being an effective anti-inflammatory, it has been shown to help replenish and repair the proteoglycans that are necessary for joint lubrication and movement (Hahn, 2005). Its sulfur component is an essential part of cartilage.

Side effects include gastrointestinal disturbances and the possibility of increased insulin resistance in susceptible individuals (Hahn, 2005), so its use with diabetic clients should be carefully monitored.
• 1500 mg daily, preferably on an empty stomach. Effects may not be noted for up to six weeks but will be maintained 4–8 weeks after cessation of treatment.

- **Chondroitin sulfates**, often used with *glucosamine*, have a similar but larger molecular structure. They inhibit degradable enzymes and stimulate the synthesis of glycosaminoglycans and proteoglycans in connective tissue cells (Bucci, 1995, p. 184). Chondroitin is generally included in glucosamine supplements but is considered less effective, possibly due to absorption difficulties caused by the size of the molecules. (Hahn, 2005).

- 400 mg 2X/day

- **Antioxidants**, despite their spotty research record, do appear to reduce levels of DNA oxidation, oxidized glutathione, and other parameters of oxidative damage. The research is particularly positive for the benefits of vitamin C (Hamilton, n.d.), which is vital for connective tissue repair. Antioxidants work much better in synergistic combinations and are best obtained from food, except in cases where needs are greater than usual, such as in endurance athletes, the aged, and the nutritionally compromised.

Where the research becomes more certain is in the reduction of post-workout muscle soreness.

An optimally functioning antioxidant system seems to minimize free-radical damage to muscle cells, thus reducing muscle soreness, and also appears to enhance post-workout muscle damage repair (at least where research exists, which is for older runners) (Hamilton, n.d.). Once again, though, there is contradictory evidence in the research for antioxidant supplements. There is no argument, however, about the need for antioxidant foods, so again the emphasis should be on these.

- **Anti-inflammatory Herbs:**
  - **Curcumin**, the yellow pigment and the main curcuminoid in the herb turmeric, has a long history of use in Ayurvedic medicine and has been well-studied for its beneficial properties. Arora et al., in 1971, found curcumin (as well as another unnamed compound in turmeric) to have as much anti-inflammatory activity as hydrocortisone. It has also been shown to be an antioxidant, both directly and through the synthesis of glutathione, and
to inhibit several substances responsible for inflammation (Higdon, 2005). Taken orally, its bioavailability is low, so doses of 3.6 gm or higher are recommended. According to Dr. Barker (d, 2006), curcumin also stimulates tissue repair, mainly the regeneration of muscle tissue, so this agent is particularly useful for injuries involving muscles.

**Side effects appear to be rare.**

- **Ginger** (Zingiber officinale), a medicinal herb used for thousands of years in India and China and a relative of turmeric, is recognized as a potent anti-inflammatory and antioxidant. Two meta-analyses found moderate evidence for its use in degenerative joint conditions (Sodhi, 2007). Ginger also has analgesic, antihistaminic, and anti-toxicity properties and contains a proteolytic enzyme (Sodhi, 2007), all of which may be useful for athletic injury relief and repair.

  According to Sodhi (2007), effective study doses (for arthritis) were 500 – 1000 mg daily, taken for 3 months to 2 1/2 years.

- **Cayenne Pepper** (Capsicum annum), whose main component is capsaicin, may help prevent inflammatory eicosanoid production and may deplete a neuropeptide necessary for transmitting pain signals to the central nervous system (Percival, 2002).

- **Boswellia** is a gum resin from the Boswellia serrata tree. It is used traditionally in Ayurvedic medicine as an anti-inflammatory agent. The main active constituents, boswellic acids, have been shown to inhibit inflammation and may also inhibit a part of the immune system whose sustained activation is believed to create ongoing inflammation (Percival, 2002).

- **Stinging Nettles** (Urtica dioica) also have a long history of usage, mainly for disorders of the joints. Recent studies have shown it to relieve pain and to have a mild anti-inflammatory effect (Grauds et al., 2002). It can be taken as a tea, fluid extract, or tincture, and it can be used topically in cream form for joint pain, sprains and strains, and tendonitis.

  **Side effects are rare but may include mild stomach upset, fluid retention, and sometimes hives when used topically. It should not be used by pregnant women** (Grauds et al., 2002).

- **Devils Claw** (Harpagophytum procumbens DC) is a plant found in the Kalahari and Savannah desert regions of South and Southeast Africa. Its dried roots are used medicinally. An extensive body of research does not exist for it, but traditional use, along with what research there is, suggest that it is most effective for short-term relief of inflammation in the joints. Traditional usage also indicates it has antioxidant properties and is effective for knee pain and tendonitis (MedLine Plus, 2008).

  MedLine (2008) indicates that potential side effects include gastrointestinal disturbance, low blood pressure, and abnormal heart rhythms, and that it is contraindicated for use with blood thinning medications.

  - 670 mg–2 gm of powder daily, with >50 mg daily of the active ingredient, harpagoside, has been shown to be effective for inflammation (Ameye et al., 2006)
Other herbs that have either been shown to have anti-inflammatory properties or have been used traditionally for this purpose (and haven’t already been mentioned in this article) include:

- Ashwagandha
- Feverfew
- Guggul
- Holy basil
- Hops
- Oregano
- Rosemary
- White willow bark

It is not known whether any of these would be effective for athletic injuries.

Adaptogenic Herbs are used to balance the body’s response to stressors. Because they can be used to improve endurance during exercise (Bone, 2008) and to help the body adapt to stress, they can provide a second line of defense against athletic injuries. Anything that strengthens the body and helps with physical performance and recovery will help prevent it from getting hurt. Some of the best adaptogens for athletic purposes are:

- *Rhodiola rosea* (Barker, June 2008);
- *Asian or Korean ginseng* (Panax ginseng) (Bone, 2008); and
- *Schisandra* (Schisandra chinensis), though to date this effect has only been tested in horses (Bone, 2008).

**CONCLUSION**

Physical activity is such an important aspect of a healthy lifestyle that preventing injuries and maintaining the health of the musculoskeletal system are essential. If these aspects of health are neglected, chronic pain and inflammation may result. A nutrient-dense whole food diet that covers every component of the Eating For Health™ model, supplemented with booster foods and herbs, is a first-line defense against injury. Lifestyle factors such as proper training, good sleep, adequate hydration, and stress reduction are likewise keys to high performance and longevity. Minor injuries, at least, are likely to occur with the repeated stress and strain on bones, joints, muscles, and tendons that comes from regular athletic activity. It is reassuring to know that there are safe and effective natural means to ease symptoms and allow the healing process to ensue. Using proteolytic enzymes, zinc, vitamin C, and bioflavanoids rather than over-the-counter pain relievers can prevent serious degeneration. Even when short-term drug treatment is utilized, specialized nutrients support recovery in all musculoskeletal conditions. Let’s remind our friends, family members, and clients to eat for health so they can continue to perform at a high level well into advanced age.

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