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Nutritional Protocol for Osteoarthrosis (Degenerative Joint Disease)

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Abstract

This paper is a review of the current literature on the effects of alternative approaches to treating osteoarthrosis. There are specific recommendations in regard to nutritional supplements and botanical medicines.

Keywords: Osteoarthrosis; Natural supplements; Botanical medicine; Diet

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Introduction

Osteoarthrosis (OA) is sometimes referred to as osteoarthritis, degenerative arthritis, or degenerative joint disease. It is characterized by degeneration of the articular cartilage and subchondral bone. It can result in joint deformities, with characteristic Bouchard's nodes in the proximal phalangeal joints of the fingers and Heberden's nodes in the distal joints of the fingers. The predictable symptoms include joint pain and stiffness, becoming more chronic over time. Other symptoms commonly included joint swelling, weakness and/or paresthesias in the extremities and decreased range of motion. Typically, joints in the fingers, thumb, knees, spine, and hips can be involved. It can also be the result of trauma to a single joint leading to degeneration of the joint years later. Abnormal cartilage, congenital deformities of joint(s), infection of a joint, crystal deposition and/or other arthritic conditions can lead to OA of the joint.

Approximately 27 million people in the U.S. suffer from OA [1]. As people age, the prevalence of OA increases. In people under 45, it's more common in men. After 45, it is more common in women. The knee is the most common joint to be affected. Conventional treatments include exercise, acetaminophen, NSAIDs, opioids, injecting anesthetics, hyaluronan (hyaluronic acid), or platelet-rich plasma, or joint replacement. One peculiar finding is the lack of correlation between the severity of the disease as seen on radiographs and the patient's symptoms.

Conventional Pharmaceutical Treatment

Conventional treatment includes non-steroidal anti-inflammatory drugs. While their use is widespread, there is some evidence that long-term use may inhibit the synthesis of the cartilage matrix and accelerate the deterioration of cartilage [2-5]. However, there is some evidence that is contradictory. There are some studies that demonstrate that the anti-inflammatory effects of low-dose aspirin slow the progression on cartilage loss in OA [6]. Additionally, there are significant risks associated with the use of NSAIDs; including gastrointestinal bleeding and cardiovascular events.

Manual Medicine

Musculoskeletal joint derangement and misalignments have been demonstrated to play a role in the development of OA. In one study involving 230 patients with varus deformities of the knee, the was a four-fold increase in degenerative arthritis in the knee when compared to the general population [7]. Joint alignment, muscle strength nutritional status, previous trauma and mid-stance loads all seem to contribute to the development of OA [8,9]. Manipulative and manual therapy has both been shown to increase range of motion, decrease pain, and decrease the need for pain medicine [10-12]. One study concluded that the cost of treatment was reduced when manual therapy and exercise were integrated into the treatment plan [13]. Swimming and isometrics have been identified as superior to other types of exercise for the treatment of OA [14-15]. Decreased stability and balance have been demonstrated to have a negative effect on OA, particularly in the knee [16]. Conversely, strengthening the muscles controlling the hip and knee is an effective way to mitigate some of the disabling symptoms associated with OA in the lower extremity [17].

Diet

Diet should focus on the decrease of inflammation, as well as improving insulin sensitivity and achieving ideal body weight. Obesity is a major risk factor for the development of OA in the knees and hips. There is considerable evidence linking metabolic syndrome (syndrome X) with inflammatory cytokines implicated in OA [18-21]. Insulin stimulates chondrocytes and chondroblasts to secrete proteoglycans, which are essential to the proper function of cartilage. Decreased sensitivity to insulin has a detrimental effect on cartilage [22]. Combining weight loss and exercise is known to decrease the risk of developing OA, as well as reducing the symptoms of OA and improving function [23].

General guidelines for diet include a plant-based diet, relying on fresh fruits and vegetables, as well as whole grains, fatty fish and lean meats. Dairy products and gluten-containing grains are known to be allergenic in many people, and therefore should be minimized or eliminated from the diet. The Mediterranean diet has been show to significantly improve the symptoms of OA [24]. Certain individuals may benefit from eliminating nightshades (tomatoes, white potatoes, peppers, and eggplant) from the diet, most likely because of an individual's sensitivity to these plants. One study looked at Diosgenin, a steroidal saponin found in nightshades. Diosgenin possesses diverse biological activities including anti-inflammatory properties. It has been shown to inhibit the synthesis of inflammatory mediators, such as prostaglandin E2 and interleukins. Therefore, there is a possibility that these plants may actually be beneficial for OA [25].

Supplements

Glucosamine sulfate

Glucosamine sulfate is a relatively small molecule, consisting of glucose and an amine. One of the most common monosaccharaides, it is found in the exoskeletons of crustaceans and arthropods, and in the cell walls of fungi. It is known to stimulate the production of Glycosaminoglycan's (GAGs), a major component of cartilage. Aging appears to reduce the individual's ability to manufacture glucosamine [26,27]. Oral supplementation with derivatives of N-acetyl glucosamine has been shown to have superior cartilage protection over glucosamine sulfate supplements [28]. Glucosamine sulfate supplements have demonstrated efficacy in treating OA, as well as a wide-margin of safety [29]. While not all studies have proven the positive effects of glucosamine sulfate supplementation [30], the overwhelming majority of the studies support its use for treatment of OA [26-29,31-32], especially the crystalline form [33].

Chondroitin sulfate

Chondroitin sulfate is a high molecular weight GAG, found naturally as a component of cartilage. It is composed of repeating units of glucosamine sulfate, a GAG that is much smaller than chondroitin sulfate and much better absorbed. Chondroitin sulfate is generally poorly absorbed, anywhere from 0-18% of what is ingested. The research is mixed as far as the results of oral chondroitin sulfate on OA since it has to be partially digested to be absorbed. Administration of low-molecular weight chondroitin sulfate has been demonstrated to have beneficial effects on the alternative complement pathway, thus preserving chondrocytes and preventing damage to cartilage [34]. Immunoassays specific for a peptide of the alpha-helical region of type II collagen 108HRGYPGLDG116 (Coll 2-1) were used to determine the effect of chondroitin sulfate on OA. The authors used visual analog scale to determine pain, and Lequesne's Index to measure function. They concluded that chondroitin sulfate supplements positively affected OA, reducing Coll 2-1 levels, resulting in decreased pain and increased function [35]. Other studies have shown that combining chondroitin sulfate with hyaluronic acid and keratin improved OA [36]. Chondroitin sulfate supplements have been shown to inhibit NF-κB activity, thus preventing further damage to cartilage [37].

Hyaluronan (Hyaluronic acid or HA)

Hyaluronan is a GAG found in synovial joints, between layers of fascia and in loose connective tissue. It allows cartilage to imbibe water and provides an excellent medium for diffusion. By age 70, the amount of HA found in the body is estimated to be as little as 20% of that of a forty year old [38-40]. This is implicated in dry skin and poor wound healing so prevalent in the elderly, as well as accelerated rates of osteoporosis. Both oral and injectable versions of hyaluronan have been shown to be beneficial in treating OA [41-45]. *In vitro* experiments have shown that hyaluronan has a positive effect on the growth of chondrocytes as well [46].

S-adenosylmethionine (SAMe)

SAMe is a combination of methionine and ATP (adenosine triphosphate). It is important in cartilage in that a deficiency results in a loss of the integrity of cartilage in regard to shock absorption. Some proposed mechanisms are the decrease in TNF-α [47,48], increasing levels of glutathione peroxidase, signaling of proteoglycan synthesis, increased methylation of proteoglycans, and positive effects on DNA synthesis in cartilage by acting as a signal of sulfur availability [48,49].

Niacinamide

There were several studies in the 1940s and 1950s by William Kaufman that reported significant benefits from supplementing with niacinamide in patients with OA. Niacinamide has been shown to prevent apoptosis of chondrocytes by inhibiting cytokine (IL-1) stimulated nitric oxide synthase [49]. This has been shown to be an important mechanism in the development of OA [49]. Administration of niacinamide in patients with OA improved joint flexibility, reduced inflammation, and reduced the need for pain medication [50]. Due to the short half-life of the vitamin, taking niacinamide in divided doses yielded the best results.

Antioxidants

The intake of carotenoids, ascorbate and vitamin E have all been demonstrated to improve the symptoms of OA and even to reverse the progression of the disease [51,52]. The odds of having hip OA were reduced by nearly two fold when

the individual consumed recommended or higher amounts of vitamin C [53]. It has been demonstrated that vitamin C protects chondrocytes from oxidative damage from hydrogen peroxide by regulating multiple regulatory pathways [54]. Astaxanthin, a carotenoid found in a variety of marine mammals and plants, has been shown to reduce Matrix Metalloproteinases (MMP), a substance known to degrade cartilage [55,56]. The carotenoids in saffron, namely crocins and crocetin, are known to prevent the expression of MMP due to IL-1β [57,58].

Vitamin D

According to several studies, low plasma levels of vitamin D are associated with an increased risk of OA [59-61]. However, there are some studies that contradict these findings [62,63]. Improved outcomes following knee arthroplasty were noted after vitamin D supplementation [64]. Vitamin D has been shown to have a positive effect on the mass of the quadriceps muscles [65]. It seems that inadequate levels of vitamin D contribute to the progression of OA, but it is not clear whether supplementation is beneficial in improving symptoms in those afflicted with the disease.

Vitamin K

Low vitamin K status is associated with an increased incidence of OA [66-68]. The anti-inflammatory effects of vitamin K are thought to play an important role in the prevention of OA. The carboxylation of osteocalcin is dependent on vitamin K. Vitamin K deficiency caused serum undercarboxyled osteocalcin levels to increase. Measuring these levels has been suggested as a marker for the potential development of OA [69]. Mineralization of cartilage has been observed in osteoarthritic cartilage. Chondrocytes from osteoarthritic tissue produced significantly less amounts of matrix GLA protein, a known inhibitor of mineralization. This correlates with lower than normal vitamin K status [70]. A study that included 719 subjects looked at the relationship between vitamin K levels and OA and concluded that "vitamin K may have a protective role against knee OA" and that supplementing with vitamin K "might lead to a disease-modifying treatment" [71].

Zingiber officianalis (Ginger)

Ginger is well-known for its anti-inflammatory and anti-nausea effects. A recent study used a combination of ginger and *Echinacea purpurea* to treat OA patients that did not respond well to NSAIDs, and demonstrated significant improvements [72]. In several studies, ginger was shown to inhibit inflammatory cytokines and prevented the degradation of cartilage [73-75]. Even topical applications of ginger have been shown to be helpful in improving the symptoms of OA [76].

Harpagophytum procumbens (Devil's Claw)

Devil's claw is a plant native to South Africa. It is known to possess several compounds that block the expression of inflammatory cytokines [77]. Fewer than 30 mg per day seemed to have little effect on OA, whereas supplements containing 60 mg or more were mildly effective in relieving the symptoms of OA [78-80]. There was one case study reporting hypertension caused by *H. procumbens*, therefore caution should be exercised when prescribing to a patient that is borderline or hypertensive [81].

Boswellia serrata

Boswellia serrata is a tree used to treat inflammatory conditions. Out of twelve boswellic acids purified from the resin of the tree that have been identified, two are of particular interest in treating chronic inflammation. KBA and AKBA have both been shown to inhibit the secretion of a variety of pro-inflammatory cytokines, including IL-1, IL-2, IL-6, IFN-γ and TNF-α, products of complement and inhibition of leukotrienes [82]. Two studies by the same group used an extract of *Boswellia* called FlexiQule, demonstrated reduction in pain and improved mobility when compared to control groups [83,84]. Another study reviewed several botanical medicines for the treatment of OA and concluded that *Boswellia* extracts are effective in treating OA through a number of mechanisms [85]. Yet another study looked at combining Curcumin and Boswellia proved to be more effective than a COX-2 inhibitor, celecoxib. The combination of the two herbs was without side effects [86].

Curcuma longa

There are a number of studies touting the anti-inflammatory effects of *C. longa* [87-90]. It has been well-established that *C. longa* disrupts a number of inflammatory pathways. In a study comparing *C. longa* to ibuprofen, the benefits were similar in the two treatment groups, but the curcumin-treated group had significantly less gastrointestinal symptoms [91]. Another multi-center study confirmed these results [92]. Another study deemed *C. longa* as an alternative to traditional pharmaceuticals for treating OA due to its excellent safety record and low cost [93]. Multiple studies strongly recommend the use of *C. longa* in the treatment of OA because of its long history of safety and efficacy [94-96].

Proteolytic enzymes

Papain, rutin, bromelain, trypsin and chymotrypsin are all proteolytic enzymes that are used clinically for inflammatory conditions. Papain, rutin and bromelain are from vegetable sources, and trypsin and chymotrypsin are derived from bovine or porcine pancreas. To mitigate the effects of inflammation, proteolytic enzymes must be taken away from food. Several studies looked at the efficacy and safety of proteolytic enzymes and concluded that they are as good or superior to pharmacological agents, with a superior safety record [97-101]. Two studies compared diclofenac and proteolytic enzymes and concluded that the enzyme treatment was as effective as diclofenac, but was safer to use and had a fewer side effects [97,98].

Summary

Osteoarthritis is a debilitating disease that affects over a third of Americans over the age of 60. Natural approaches to treatment of the disease and its symptoms have been shown to be effective and cost saving. Combining a diet rich in omega-3 fatty acids,

flavonoids, and high in fibre with supplements and botanicals, has the potential of halting the progression of the disease and even reversing some of the damage to joints.

Supplements

Glucosamine sulfate: 1500 mg/day;

Niacinamide: 500 mg 6x/day;

Beta-carotene: 25,000 IU/day;

Vitamin C: 1000 mg 2x/day; *Can cause loose bowels or diarrhea in high doses;

Vitamin E: 400 IU 2x/day; *Can cause a temporary hypertension in patients who are borderline HTN;

Vitamin K: 750 µg/day;

Pyridoxine (B_6): 50 mg/day;

Pantothenic acid (B_5): 30 mg/day;

Hyaluronan: 60-100 mg 2x/day;

SAMe: 500 mg 3x/day;

Zinc: 50 mg/day m; *Must be taken with copper to avoid a copper deficiency;

Copper: 3 mg/day;

Boron: 6 mg/day.

Botanicals

Ginger: 1000 mg 3x/day;

Devil's claw: 60 mg of harpagoside/day;

Boswellia serrata: 400 mg of boswellic acids 3x/day;

Curcumin: 500 mg 3x/day;

Proteolytic enzymes: mixture of bromelain/papain/rutin/trypsin/chymotrypsin 500 mg 3x/day on an empty stomach.

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