

Contemporary Medical and Surgical Management of Osteoarthritis

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Abstract: Osteoarthritis (OA) is a common joint disorder that afflicts more than 20 million Americans, with greater than 80% of individuals older than 75 years of age demonstrating radiographic evidence of disease. Initial treatment involves behavioral modification with emphasis placed on weight loss, exercise, and patient education. Simple oral analgesics such as acetaminophen and nonsteroidal anti-inflammatory medications may be employed in conjunction with topical treatment. If pain relief proves inadequate, intra-articular steroid and hyaluronic acid products may be used. Pain relief and restoration of function may be achieved during the early course of osteoarthritis. For joints demonstrating focal degenerative disease, alternative surgical options are available such as arthroscopic debridement, autologous chondrocyte implantation and osteochondral allograft. Advanced disease ultimately requires partial or complete joint replacement, generally providing excellent results.

Introduction

Greater than 20 million Americans are affected by osteoarthritis (OA), a common joint disorder that affects 70 to 90 percent of individuals older than 75 years of age. Osteoarthritis afflicts men and women equally, but symptoms tend to present earlier and with more severity in females¹ Even though osteoarthritis is not an inevitable outcome of aging, nearly 60% of the population over the age of 65 meets the radiologic requirements for this disease.² OA commonly occurs in the following joints in order of decreasing prevalence: first distal inter-phalangeal joint, first carpometacarpal joint, proximal interphalangeal joint of the hand, metatarsophalangeal joints of the feet, facet joints of the cervical and lumbar spine, knee, and hip.³

Risk factors implicated in the initiation and progression of disease include age, ethnicity, gender, hormonal status, bone mineral density, nutritional factors, genetics, obesity, trauma, joint mal-alignment, muscle weakness, joint laxity, and problems with proprioception.³ The financial burden on society involves both direct (physician visits, medications, joint replacement, rehabilitation) and indirect costs (time lost from work).² It is estimated that by 2020, the cost to society of lost productivity will approach 1% of the gross national product.³ Though there is no known “cure”, there are non-pharmacologic, pharmacologic, and surgical modalities that may be employed to treat joints affected by osteoarthritis. Non-surgical methods are utilized to reduce joint pain, improve

joint mobility, reduce further joint damage, and prolong the time interval to surgery.

Etiology

The exact cause of osteoarthritis has not been elucidated. There are multiple factors which may contribute to the initiation and progression of the disease. Each step in the process of joint deterioration is controlled by combinations of genetic, mechanical, and environmental factors. Age, heredity, trauma, and obesity play a role in the alteration of cartilage environment.^{1,3} OA is generally a primary disorder, but secondary causes may include calcium deposition, endocrinopathy, infection, neuropathy, congenital malformation, and metabolic disease.¹

Pathophysiology

OA has historically been considered to be a disease specific to cartilage degeneration, but further basic science and clinical work support the concept of whole joint involvement (including synovium, joint capsule, and subchondral bone).^{1,4} Initially classified as a non-inflammatory arthritis, recent evidence suggests that pre-inflammatory cytokines (such as IL-1 Beta, and TNF- alpha) and metalloproteinases produced by the synovium and chondrocytes (cartilage forming cells) may accelerate cartilage destruction.^{3,4} Animal models have demonstrated initial damage occurring in the superficial layer of cartilage with resultant disorganization of the collagen network and swelling. An initial hypertrophic response by the chondrocytes results in increased production of proteoglycans, a critical component of the extracellular portion of cartilage.

Small tears, known as fibrillation, may develop with repetitive micro-trauma at the articular surface. Cartilage tears may progress with failure leading to fragmentation into the affected joint. The end result is exposed subchondral bone which leads to joint laxity and deformity coupled with symptoms of joint pain, restricted motion and difficulty with weight bearing. Cartilage loss may at times be rapid, but more commonly is slow in progression with periods of stabilization generally marked by attempts (of exposed bone and mesenchymal cells) of repair with fibrocartilage.^{1,4} Increased bone formation (osteophytes) is generally noted at the periphery of the joint to dissipate the increased forces on non-cartilaginous surfaces. The exposed subchondral bone may become sclerotic or develop areas of cystic degeneration. Later stages of the disease demonstrate compositional changes in the joint fluid produced by cells lining the synovium (synoviocytes).

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The changes are characterized by increased water content and decreased hyaluronic acid, a major protein constituent of the joint fluid.^{1,4} Compositional change of the fluid affects both the nutritional supply to the avascular cartilage and shock absorption capability, predisposing the joint to further damage.^{1,4}

Diagnosis

The diagnosis of OA is primarily based on a detailed history and physical exam. The most common presenting complaint is pain involving the affected joint.^{1,3} Cartilage is aneural, avascular, and alymphatic which is in contradistinction to the joint capsule, synovium, periosteum, and subchondral bone which all have free nerve endings.³ In particular, synovial tissue and subchondral bone may serve as pain generators in OA. Morning joint stiffness, if present, generally resolves within 30 minutes. An effusion may be present. As the disease progresses, joint stiffness may be prolonged and joint deformity may be present. Crepitus, a grating sensation in the affected joint, is generally a late manifestation of OA. As mobility of the joint decreases, flexion contractures or mechanical obstruction to motion may prevail.

Secondary causes of OA should be considered when the diagnosis remains questionable or when therapy has not resulted in an expected response.^{1,3} No specific lab test abnormalities are seen with OA. Acute phase reactants and erythrocyte sedimentation rate are generally not elevated, and synovial fluid analysis usually demonstrates a white blood cell count less than 2000 per mm³.^{1,3} Radiographs, which may prove negative in the early course of OA, may serve as objective evidence of disease. Nearly 25% of individuals over 55 years of age have knee pain, but only 50% of the same group of individuals has radiographic evidence of OA.³ Findings may include joint space narrowing, osteophyte formation, subchondral cysts, and sclerosis (*Figure 1*). The Kellgren-Lawrence Grading System utilizes these radiographic features to grade severity. It should be noted that the absence of these findings does not exclude OA as the diagnosis.^{1,3}

Figure 1 Osteoarthritis of the Knee



Fifty-two year old woman with an antero-posterior standing radiograph of the knee joint. She complains of progressive pain involving her medial knee. X-rays demonstrate advanced degenerative changes with medial joint line collapse (varus alignment). Total knee arthroplasty or uni-compartmental knee arthroplasty are the appropriate surgical options. (Adapted with permission from Hanssen AD et al. Surgical Options for the Middle Aged Patient with Osteoarthritis of the Knee Joint JBJS-AM. 2000; 82:1767-1781.)

Treatment

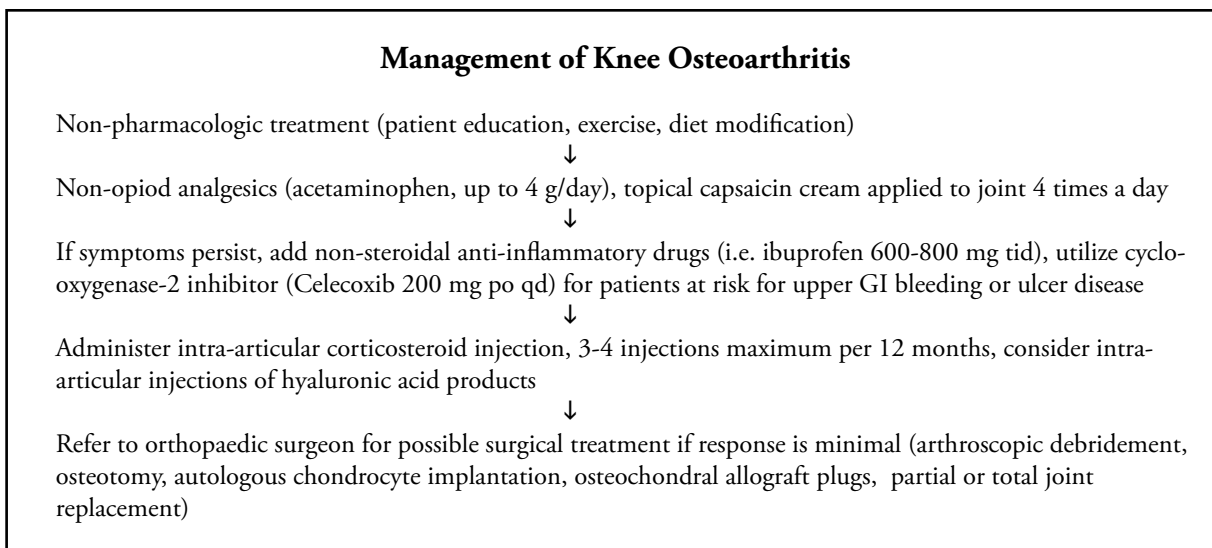
Non-surgical interventions: The primary goals of treatment are to improve joint function and quality of life. Treatment should be individualized based upon severity of OA and the patient's needs. Education regarding the natural progression of OA is critical to establish realistic patient expectations regarding current treatment modalities. There are both non-pharmacologic and pharmacologic forms of treatment, some of which may be used in combination to achieve symptom control (Table 1). Non-pharmacologic interventions include exercise, dietary modification with weight reduction, physical therapy, and ambulatory assistive devices.^{1,2,5} Weight loss with exercise and dietary modification may lessen the direct loads involving the affected joints, with the hip and knee in particular. Physical therapy should focus on stretching and strengthening of all muscles that cross the affected joint. Aerobic conditioning should also be included as part of the therapy regimen (i.e. swimming).⁵ Assistive devices for ambulation may be employed for activities of daily living when indicated. To decrease the reactive forces across a joint (i.e. the hip), a cane may be used on the side opposite of the affected extremity. Appropriate shoe wear and bracing (i.e. unloader knee braces) may also be an option in the early course of disease.^{1,2} The above treatments are generally not utilized in isolation but are combined with pharmacologic therapy to minimize symptoms and to promote return to a pre-morbid level of activity.

Medical management of OA begins with analgesics such as acetaminophen, which may be taken in doses up to 4 grams per day (contraindicated in patients with concomitant liver disease) to control pain before or after activity.^{1,2} Topical creams containing capsaicin may be used for local relief. If more pain/symptom control is required, non-steroidal anti-inflammatory drugs such as ibuprofen, ketoprofen, and naproxen may be used. Patients who have a history of gastro-esophageal or peptic ulcer disease may benefit from selective COX-2 (cyclo-oxygenase) inhibitors.^{1,2,6} Presently, Celecoxib™ (Pfizer) remains the only FDA approved COX-2 inhibitor, after Rofecoxib™ and Valdecoxib™ were removed from the market secondary to increased risks of adverse cardiac events in specific patients.^{1,2,3,6}

The efficacy of “nutraceuticals” such as glucosamine and chondroitin sulfate remains unproven based upon the current literature.^{7,8} The majority of studies that support the use of these substances have been based on clinical trials with short term follow-up, small patient numbers, and flawed experimental design. Despite the demonstration of gradual symptomatic relief, many questions remain regarding long term effects, effective dosage, product purity, and route of administration. A well-designed, randomized prospective study of glucosamine and chondroitin sulfate demonstrating efficacy in the prevention and treatment of osteoarthritis is warranted prior to endorsement.^{7,8}

Disease progression with symptom exacerbation may require more invasive treatment options such as intra-articular injections with corticosteroids or hyaluronic acid. Intra-articular corticosteroid injections provide a local

Table 1 Treatment Algorithm for Osteoarthritis of the Knee



anti-inflammatory effect by an incompletely understood mechanism of action.⁹ More commonly used formulations include methyl-prednisolone acetate, triamcinolone hexactonide, hydrocortisone acetate, and betamethasone sodium phosphate. A statistically significant reduction in pain (i.e. knee) is generally noted one week after injection. Each injection may provide up to six weeks of pain relief. Because of theoretical concerns regarding cartilage degeneration with repeated use, it is recommended that a maximum of three to four injections be given during a 12 month period. The most common side effects are post-injection flare, facial flushing, and skin or fat atrophy at the site of injection.^{1-3,9}

As an alternative, visco-supplementation with hyaluronic acid by means of intra-articular injection may be performed.^{1-3,10-13} Hyaluronic acid (HA), a polysaccharide chain of repeating disaccharide units of N-acetylglucosamine and glucuronic acid, is an integral component of synovial fluid and the extracellular matrix of cartilage. It has both viscous and elastic properties, depending on the amount of shear force applied. During rapid movements, HA acts like a shock absorber, and is effective as a lubricant during slower movements.¹⁰ A meta-analysis of 76 controlled clinical studies reported by the Cochrane group has concluded that visco-supplementation is both a safe and effective method for temporizing treatment of OA of the knee.¹¹ Intra-articular HA injections have demonstrated in vitro and in vivo (animal models) anti-inflammatory effects, which may partially explain some of the analgesic properties. The chondro-protective effect though, remains largely unproven as animal studies have indicated evidence of disease progression (osteophyte formation and enlargement of cartilaginous lesions) despite therapy.¹⁰

There are five commercially available FDA-approved hpreparations for OA of the knee, and they are administered as weekly injections for a 3 or 5 week period.¹⁰⁻¹³ The overall incidence of side effects is approximately 1% (per injection); most commonly evident as localized reactions with pain, swelling, and skin warmth.⁸ Viscosupplementation is expensive with non-Medicare prices ranging from \$500 to \$700 for a series of 3 or 5 weekly injections.¹⁰

Surgical interventions: Patients with OA may develop symptoms refractory to nonsurgical management. Appropriate consultations with an orthopaedic surgeon or rheumatologist (if rheumatoid arthritis is suspected) should be obtained. From a surgical standpoint, there are several options available to patients including arthroscopic joint lavage and debridement¹⁴, realignment procedures (osteotomy)¹⁵⁻¹⁸, joint fusion (arthrodesis), and joint replacement (arthroplasty).¹⁹⁻²³ Current orthopaedic research has focused heavily on cartilage repair with important advances noted in stimulation of intrinsic repair mechanisms (microfracture), regeneration (autologous chondrocyte implantation), and substitution techniques (osteochondral allograft or autograft plugs).^{24,25} The primary objectives of these treatments are to obtain pain relief, reduce joint inflammation, restore function, reduce disability, and postpone joint replacement.²⁰ Despite current advances, duplication of articular cartilage remains an elusive goal. As a result of disease progression, patients will ultimately seek definitive pain relief and improved joint motion in the form of partial or total joint replacement.¹⁹⁻²³

Conclusion

The treatment armamentarium for OA includes the spectrum of behavioral, pharmacologic, and surgical modalities. Current forms of therapy mitigate the symptoms of OA, but do not halt the progression of disease. Continued basic science research involving cartilage repair may elucidate mechanisms that allow for pharmacologic intervention and possible slowing or reversal of disease progression. Partial or total joint replacement continues to provide satisfactory long term results to those individuals with end stage OA who wish to have permanent symptomatic relief and return to a pre-morbid level of function.

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DCMS Members Running for FMA Office

Two DCMS members are running for FMA office. They are Alan Harmon, MD, a nominee for FMA Treasurer and AMA Delegate; and Eli N Lerner, MD, a nominee for District B Representative to the FMA Board of Governors.

The Florida Medical Association Annual Meeting is August 23-26 at the Westin Diplomat Hotel in Hollywood, Florida.

Dr. Alan Harmon



Dr. Eli Lerner



Best Wishes, Gentlemen!

