

Management of Hand Osteoarthritis with the Use of Padded Gloves: A Review of the Literature

Osteoarthritis is a degenerative joint disease affecting nearly 27 million Americans, making it the most common type of arthritis.¹ It is a major cause of work disability and reduced quality of life. Arthritis can affect the hands causing pain and stiffness throughout the hand and fingers, yet there are many alternative methods to manage osteoarthritis of the hand. Repetitive micro-trauma is one cause of osteoarthritis described as repetitive use of the hand from occupational and leisure activities.² Arthritis gloves have been designed to decrease the effort and stress on the joints of the hand and fingers resulting in a decrease in pain, swelling and stiffness. Gloves have been recently and successfully designed for use during the sport of golf. The purpose of this paper is to review the causes and risk factors of hand osteoarthritis (HOA), and to address appropriate management of a patient with HOA with the use of gloves for joint protection.

Overview of Hand Arthritis

Arthritis is the leading cause of disability in the United States with an estimated one out of every five people having at least one affected joint. Typically occurring from either disease or trauma, half of arthritis sufferers are under age 50. One particular study in the United States found that among individuals older than 26 years, the prevalence of radiographic-confirmed osteoarthritis of the hand (HOA) and symptomatic HOA was 27.2% and 6.8%, respectively. The exact number of people with arthritis of the hand is unknown, however it is reported the hand is the most frequently affected area of the body. Pain and decreased function are the primary features of HOA which significantly decreases the quality of life for those who suffer from it.¹

The anatomically small size of the bones and joints within the hand also make it a unique site for treatment. Because medical treatments and surgical interventions are not as well developed in comparison to osteoarthritis of the knee, hip, and shoulder, current guidelines for the management of HOA is centered primarily on pain management.^{1,3}

Evolving Etiology and Risk Factors

Once regarded as simply a degenerative process within the musculoskeletal system, the etiology of OA has become exceptionally complex and is no longer considered exclusively a disease of joint cartilage. The representation for OA development involves the entire joint and includes such pathological changes as loss of articular cartilage, osteophyte formation at the joint margins, subchondral bone remodeling with cysts and sclerosis, ligamentous dysfunction, muscle dysfunction, and synovial inflammation. (FIG 1) Yet, the basic biomechanical process remains the same as any accelerated damage to

cartilage leads to bone-on-bone contact, pain, stiffness, and dysfunction. In regards to the biochemical nature of the disease, data exists indicating that chemical inflammatory components play a role in altering the balance between cartilage buildup and breakdown. It would then suggest that a systemic understanding of OA is also necessary in order to provide optimal treatment.^{2,3}

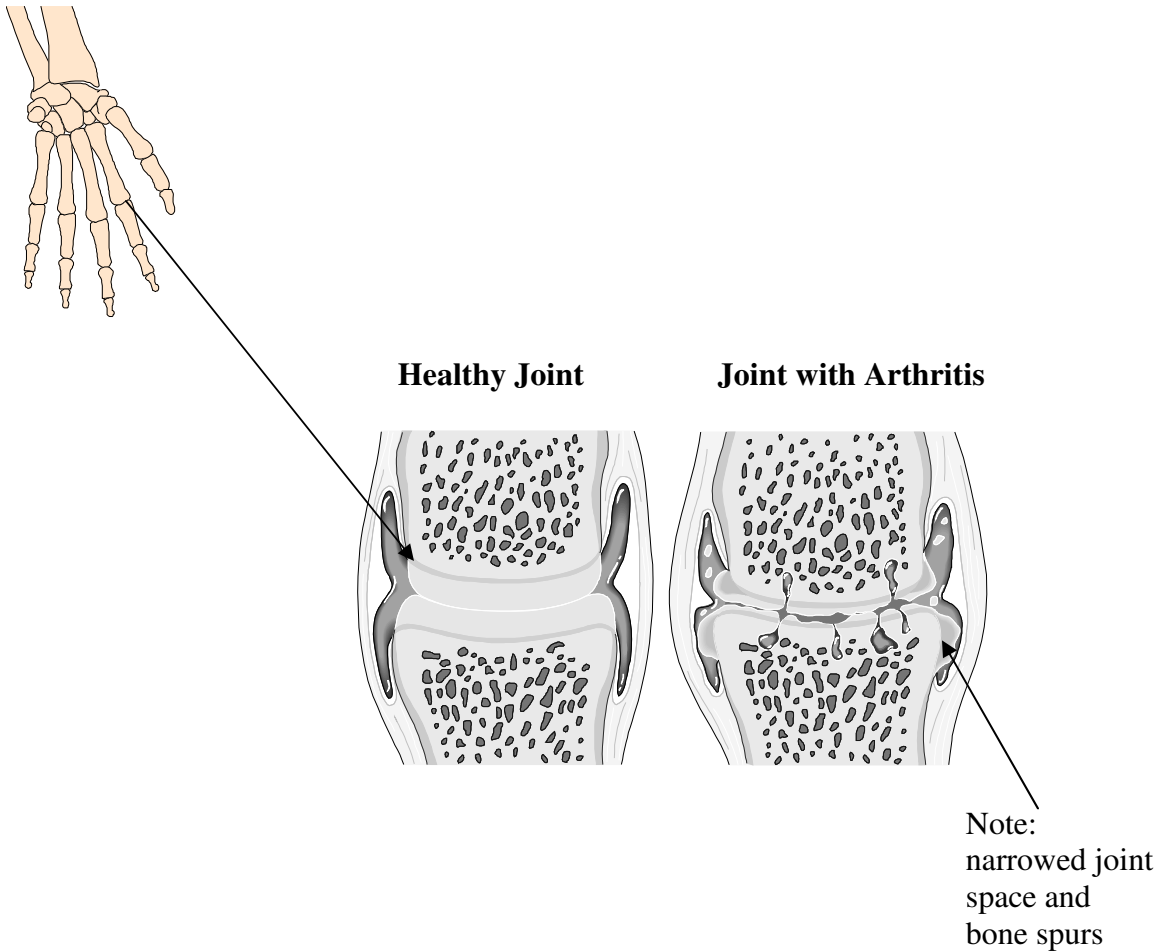


FIGURE 1

(SmartDraw 2009)

Although not a necessity for the development of HOA, a history of various occupational or recreational activities involving repeated hand and wrist motions is often present. This theoretical link to the gradual “wear and tear” hypothesis is simply stated as increased usage causes a thinning of the cartilage and when that damaged cartilage cannot be replaced, osteoarthritis results. The effect of activity on HOA is quantity dependent and

shows differential distributions of joints involved depending on the particular repetitive task.^{1,2}

It is important to understand a correlation between osteoarthritis and obesity in the context of weight-bearing joints such as the hip or knee. However, obesity is also a known risk factor for the development of HOA. This finding supports the systemic and biochemical nature of the disease. Endocrine function of adipose tissue is one proposed mechanism of causation with the possibility of increasing the systemic levels of adipokines, such as leptin, which potentially impacts cartilage throughout the body. Evidence suggests in studies of knee osteoarthritis that body fat percentage, not increased weight or body mass index (BMI), is the important feature in this relationship.¹

Sex of the individual is another predictive factor as females have a higher incidence of osteoarthritis than males. Rheumatoid arthritis (RA), another major cause of hand pain, also has higher prevalence in women. These two entities can be differentiated by a combination of age of onset, clinical presentation, joints presenting with pain, and laboratory testing. Family history is also a pertinent risk factor for rheumatoid arthritis, although a specific genetic component has not been identified.^{1,2}

Pathology of Hand Arthritis

Loss of articular cartilage and osteophyte formation at the joint margins are two of the primary pathological changes seen in HOA. Joint cartilage's mechanism is often referred to as nature's "shock absorber" as the cartilage provides a smooth gliding joint surface and provides a protective cushioning affect within the joint. All arthritic joints as also observed in the hand, lose cartilage over time resulting in worn, diminished and damaged cartilage. This process is also due to disease or trauma, and/or microtrauma. In either case, the joint no longer has a painless, mobile area of motion. The body attempts to compensate for the reduced or lost cartilage by producing synovial fluid in the joint lining which tries to enhance a cushion affect within the joint. The increase in synovium also causes an increase in joint swelling which restricts motion and causes stretching of the joint capsule thereby causing pain. Over time, if the HOA is not treated, the carpal, metacarpal and other bones that make up the joints of the hand can potentially lose their anatomical shape causing more pain and limitation of movement.^{1,2,3}

Symptoms of HOA

As joint cartilage within the hand becomes worn, the smoothness within the gliding joint surface decreases and any protective cushioning that cartilage may provide within the joint becomes diminished. Initial symptoms of HOA include pain described often as a "dull" ache or "burning" sensation. The pain often occurs after periods of increased hand and wrist use, such as heavy gripping or grasping and/or repetitive motions with or

without resistance. Pain may not always be present immediately, but may present itself hours later or even the following day. Morning pain and stiffness are typical of HOA, however in advanced cases pain may be exacerbated at night causing significant difficulties with restful sleep. Symptoms eventually occur with increased frequency and with less use/activity demands ^{1,2}

If the arthritis is also exacerbated from damaged ligaments, instability within the joint can be present resulting in the joint feeling unstable or “loose”. This can also be associated with excessive friction of the joint surfaces resulting in joint crepitation often described as a grating or grinding sensation. In such advanced cases, due to a combination of bone changes, loss of cartilage, and joint swelling the joints of the hands and wrist may become hypertrophic resulting in a larger than normal appearance. ^{1,3}

HOA and Micro Trauma

Repetitive micro-trauma is one cause of osteoarthritis described as repetitive use of the hand from occupational and leisure activities. Osteoarthritis occurs as a result of the release of fibrinolytic factors damaging joint cartilage. Repetitive micro trauma of hands is common in data input personnel, secretaries and dentists but is also common in many sport/recreational activities such as baseball, golf and tennis. For example, in some parts of the world, there are still workplaces where people use mechanical typewriters. In this case, the distal (DIP) and proximal (PIP) interphalangeal joints are exposed to stronger mechanical force in mechanical typewriter use as compared to keyboard use and subsequently documented to accelerate the arthritic process. One particular study looked at the effect of mechanical stress on finger osteoarthritis by comparing women from two occupations with different hand load demands but the same socio-economic backgrounds, and investigated further whether hand load may affect the pattern of joint involvement in OA. Among other conclusions, researchers found that continuation of the joint overload may lead to joint impairment and that osteoarthritis is significantly associated with decreased hand strength. ^{1,2,3}

The effects of repeated microtrauma to the hands of athletes have been well documented. In one particular study by Koman et al. research confirmed that damage to the small blood vessels in the hand of baseball players, particularly catchers, may occur before the player ever notices symptoms or seeks medical advice about his symptoms. The authors of the study concluded that catchers who were otherwise healthy showed evidence of microvascular changes in their hands, and that these changes occurred before the athletes developed obvious ischemia in their hands. The study concluded that further study into glove design and padding protection is necessary to make appropriate modifications to the gloves that protect the hands of professional baseball players.

Repeated mechanical trauma to the hand can also result in conditions called frictional hand dermatitis (FHD) and hyperkeratotic hand dermatitis (HHD), both of which are forms of irritant contact dermatitis. These conditions can be chronic and debilitating and are often unresponsive to many therapies.¹

Most case reports of FHD describe avoidance of frictional trauma as a management solution. FHD can be defined as an eczematous process in which physical frictional trauma on the hands primarily causes or secondarily contributes to the induction of a dermatitis process. Distinguished by a mechanical factor such as trauma, friction, pressure, or vibration, this condition is frequently seen in patients who repeatedly handle paper, cardboard, fabric, or small metal or plastic components.^{1,2,3,4}

Glove Technology and Hand Osteoarthritis

Repetitive high grip exertion and impact forces placing stress on hand and finger joints has been identified as a risk factor for work related musculoskeletal disorders. Evidence-based recommendations on management of hand osteoarthritis developed by the European League Against Rheumatism places importance upon hand joint protection throughout activities of daily living. Joint protection is a concept routinely presented in all patients whose joints are affected by arthritis of the hand and wrist. Originally designed for rheumatoid arthritis, the concept has been expanded to include osteoarthritis by finding ways to reduce microtrauma to articular cartilage and subchondral bone. For persons with osteoarthritis, joint protection is designed to strengthen muscular support, improve shock absorption around a joint, and reduce mechanical stress on the joint with different techniques or devices. In an effort to evaluate the importance of joint protection in hand osteoarthritis, one recent study evaluated the effect of joint protection in combination with a hand exercise as intervention in persons with hand osteoarthritis. After a treatment period of 3 months, the exercise and joint protection group was compared to a control group who did not use any form of intervention. Compared to the control group grip strength data improved significantly in the joint protection and exercise group.⁴

As the country's population ages, manufacturers of consumer goods have become more aware of the aging population and the affect that hand osteoarthritis may have upon their lives. To help product designers and engineers address those changing requirements, researchers at Georgia Tech have been developing evaluation methods to identify and address the needs of all consumers, including those with functional limitations resulting from hand osteoarthritis. One method available is the innovation and use of padded gloves that simulate the functional limitations of arthritis. The gloves reproduce the reduction in functional capacity experienced by persons with arthritis. This information then assists those responsible for consumer products and helps provide a better understanding of how arthritis affects a person's ability to grasp, pinch, turn, lift and twist objects. In essence this type of technology will help determine which activities such as opening a particular jar will be difficult for someone afflicted with hand arthritis. Through this research and technology it has been discovered that by restricting the ability to grip and turn by 35 to 50 percent a significant reduction of impact shock to the hand occurred. This information has led to the development of specific gloves used for gripping activities by protecting critical joints of the hand and restricting the range of motion of the individual's finger joints.⁵

Frictional trauma previously mentioned has been shown to be directly associated with the onset of FHD. Recent studies demonstrate that wearing anti-impaction gloves help lessen the trauma to the hands and therefore decrease the resulting dermatitic changes. In a few cases, the use of anti-impaction gloves alone was able to relieve the patient's FHD without any job modifications. Researchers found that all patients with FHD were able to return to work with the use of anti-impaction gloves, topical treatments, and in some cases modified work duties. The authors concluded that gloves with anti-impact properties are shown to aid in the return-to-work process for those with trauma related FHD. ¹

Also important in the design and development of gloves for arthritic hands are the properties of the material from which the gloves are made. Some arthritis gloves have been designed to warm the hands and decrease swelling and stiffness through mild compression. Knit gloves are designed to provide mild compression which can help relieve pain and swelling. Some arthritis gloves are made with a multilayered design consisting of an outer layer texture enabling easier gripping while the inner lining soothes the skin. Such design is described to be able to capture and retain heat from the hand. Arthritis gloves designed for more active individuals are often made of Neoprene material that retain the body's natural heat to provide warmth and pain relief to aching wrists, fingers and hands. A soft lining wicks moisture away to keep hands dry. Gloves of this material are also proposed to help conditions such as arthritis, overuse or repetitive use injuries, tendonitis, and carpal tunnel syndrome. ⁷

Technology and Properties used for Sport Gloves: A Focus on Gloves for the Sport of Golf

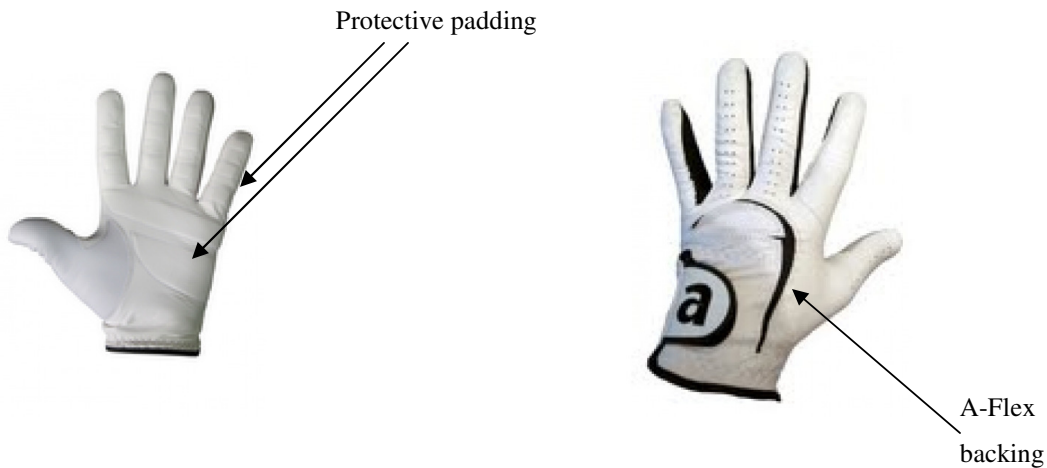
Although not considered a contact sport, golf is played on the hard ground surface and the sport requires an individual to hit the ground repeatedly whenever hitting the ball. This sport, both for leisure and professionally, allows it's participants to play as long as possible in their lives, well past the years when hand osteoarthritis becomes more prevalent. This is often not possible with other sports and recreational activities. Golfers by nature are often described as competitive, and many are reluctant to allow injury or medical conditions to prevent them from participating and applying their utmost efforts. As a result, golfers at all levels endure damage to their hands and wrists from the vibration created when the club strikes the ground and the stress put on ligaments during the swing. ⁸

Today, due to modern technology and golf research and development, golfers with hand arthritis now have options for golf gloves. Now legal under the Rules of Golf, arthritis gloves are designed with features based on the natural hand anatomy. The gloves are designed with hand position and grip in mind which are both essential components in the golf swing. Golf gloves specific for arthritis are designed to help regain club control without fatiguing the hand causing inconsistent shot and inaccuracy of the sport. This is often accomplished by thick padding well secured to the palm and fingers. The padding functions to increase the relative diameter of the golf club grasped in the hand of the user. This modified grip allows the hand position to be retained on the golf club with reduced finger MCP, PIP and DIP flexion. The limited and controlled motion of the hand and

fingers required to hold and swing the golf club lessens the amount of hand and finger strain and fatigue. ^{8,9,10}

As a result of such research and development, a company called Smooth Swing Golf has recently released the latest technological design of the padded golf glove called the AuraForm Golf Glove. This innovative design reduces stress on the hands, while maintaining dependable control throughout the swing. On the palm side of the glove the company utilizes a specific thin protective padding that not only traverses the palm side of the hand but the fingers as well. The padding is functional and therapeutic as it reduces arthritic pain in the hands, wrist and entire remaining upper extremity. This is accomplished by the absorption of shock forces from the golf club before being transferred to the cartilage between the finger, hand and wrist bones. Stress is also reduced to the joints of arthritic and non-arthritic golfers alike by limiting the range of motion while gripping the club throughout the swing. Produced from high quality cabretta leather, the padding is designed to be durable extending the effectiveness and overall life of the glove.

The dorsal (back side) of the AuraForm golf glove is designed with the company's A-Flex backing. This technology and design provides an optimal fit allowing slightly different anatomically shaped hands room to stretch. Through reducing the amount of force and joint micro trauma of the fingers, hand and wrist, long-term effects of arthritis even from an early age can be controlled and limited. It is the design and technologies as seen in the AuraForm Golf Glove by Smooth Swing Golf which allows individuals with hand arthritis to participate and enjoy their sport while experiencing a significant reduction of symptoms well into their later years.



Palmar View Glove of the AuraForm Golf

Dorsal View of the AuraForm Golf

(Smooth Swing Golf 2012)

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