



CLINICAL FOCUS

Joint Disorders

ARTHRITIS

Arthritis, an inflammation of any joint, is the most common and best known of the joint disorders, affecting 10% of the world's population and 14% of the U.S. population. There are over 37 million cases of arthritis in the United States alone. More than 100 types of arthritis exist. Classification is often based on the cause and progress of the arthritis. Its causes include infectious agents, metabolic disorders, trauma, and immune disorders. Mild exercise retards joint degeneration and enhances mobility. Swimming and walking are recommended for people with arthritis, but running, tennis, and aerobics are not recommended. Therapy depends on the type of arthritis but usually includes the use of anti-inflammatory drugs. Current research is focusing on the possible development of antibodies against the cells that initiate the inflammatory response in the joints or against cell surface markers on those cells.

Osteoarthritis (OA), or **degenerative arthritis**, is the most common type of arthritis, affecting 10% of people in the United States (85% of those over age 70). OA may begin as a molecular abnormality in articular cartilage, with heredity and normal wear-and-tear of the joint important contributing factors. Slowed metabolic rates with increased age also seem to contribute to OA. Inflammation is usually secondary in this disorder. It tends to occur in the weight-bearing joints, such as the knees, and is more common in overweight individuals. OA is becoming more common in younger people as a result of increasing rates of childhood obesity.

The first line of treatment for osteoarthritis is to change the lifestyle to reduce stress on affected joints. Synovial joints require movement to remain healthy. Long periods of inactivity may cause joints to stiffen. **Moderate exercise** helps reduce pain and increase flexibility. Exercising also helps people reduce excess weight, which can place stress on joints of the lower limbs. Older people should avoid high-impact sports, such as jogging, tennis, and racquetball, which place stress on the joints. Cycling and walking are recommended, but swimming is the best for people with osteoarthritis, as it exercises the muscles and joints without stressing the joints. Wearing

shock-absorbing shoes can help. Splints or braces worn over an affected joint may be necessary to align the joint properly and distribute weight around it.

Applying heat, such as with hot soaks, warm paraffin, heating pads, low-power infrared light, or diathermy (mild electric currents that produce heat), directly over the joint may be helpful. Moving to a warmer climate, however, does not seem to make much difference.

The American Geriatrics Society has released guidelines for managing chronic pain in elderly patients with osteoarthritis. They recommend acetaminophen (Tylenol) or other **nonsteroidal anti-inflammatory drugs (NSAIDs)**, such as aspirin and ibuprofen (Advil), for mild to moderate pain. Capsaicin, a component of hot red peppers, may help relieve pain when applied as a skin cream (Zostrix). Capsaicin seems to reduce levels of a chemical, substance P, that contributes both to joint inflammation and to the conduction of pain sensations to the brain. If pain becomes a major problem and over-the-counter pain relievers appear ineffective, physicians may inject corticosteroids directly into the affected joint.

Synvisc and Hyalgan are two drugs derived from **hyaluronic acid**, a natural substance that lubricates joints. They may be administered by injection into the joint when standard medication and exercise programs fail to relieve pain. **Glucosamine** and **chondroitin sulfate** are also natural substances associated with joints. If taken orally or by injection, they may help affected joints. However, glucosamine may also raise blood sugar levels, so people with diabetes should not use it without consulting their physician. Injections of genetically treated cells from synovial fluid, which are able to block the immune factors thought to cause the breakdown of joint cartilage, are currently under investigation. An immune system protein called **transforming growth factor beta (TGF- β)**, introduced by gene therapy, is showing some promise in repairing cartilage damaged by osteoarthritis.

If other treatments fail, **surgical procedures** may be used to relieve pain and increase function in osteoarthritis patients. Using arthroscopy, a surgeon can examine the joint and clean out bone and cartilage fragments that stimulate

pain and inflammation. In **osteotomy**, the bones of the joint are reshaped to better align the joint. In a procedure called **chondroplasty**, a small amount of healthy cartilage is removed and grown in the laboratory. The newly grown cartilage is then implanted into the joint, where it may stimulate the regeneration of damaged tissue. Research is currently underway to grow new cartilage from stem cells.

Joint replacement is discussed at the end of this "Clinical Focus." If the affected joint cannot be replaced, surgeons may perform a procedure called **arthrodesis**, in which the bones meeting at the joint are fused together. This procedure is intended to eliminate the pain, but the joint is eliminated and movement at that point becomes impossible.

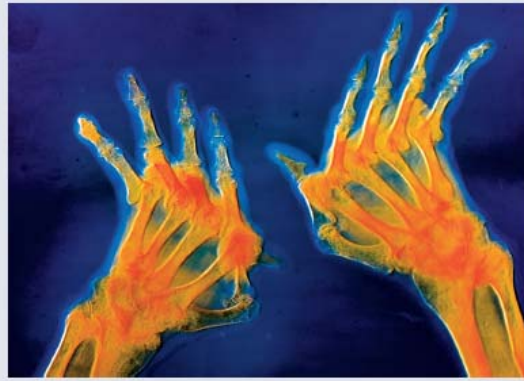
Rheumatoid arthritis (RA) is the second most common type of arthritis. It affects about 3% of all women and about 1% of all men in the United States. It is a general connective tissue disorder that affects the skin, vessels, lungs, and other organs, but it is most pronounced in the joints. It is severely disabling and most commonly destroys small joints, such as those in the hands and feet (figure C). The initial cause is unknown but may involve a transient **infection** or an **autoimmune disease** (an immune reaction to one's own tissues; see chapter 22) that develops against collagen. A genetic predisposition may also exist. Whatever the cause, the ultimate course appears to be immunologic. People with classic RA have a protein, **rheumatoid factor**, in their blood. In RA, the synovial fluid and associated connective tissue cells proliferate, forming a **pannus** (clothlike layer), which causes the joint capsule to become thickened and which destroys the articular cartilage. In advanced stages, opposing joint surfaces can become fused. **Juvenile rheumatoid arthritis** is similar to the adult type in many ways, but no rheumatoid factor is found in the serum.

Hemophilic arthritis may result from bleeding into the joint cavity caused by hemophilia, a hereditary disease characterized by a deficient clotting mechanism in the blood. Some evidence exists that the iron in the blood is toxic to the chondrocytes, resulting in degeneration of the articular cartilage.

Continued



(a)



(b)

FIGURE C Rheumatoid Arthritis

(a) Photograph of hands with rheumatoid arthritis. (b) Radiographs of the same hands shown in (a).

JOINT INFECTIONS

Lyme disease is the result of a bacterial infection (*Borrelia burgdorferi*) transmitted to humans by a tick vector (usually *Ixodes sp.*) that affects the brain, nerves, eyes, heart, and joints. The chronic arthritis and central nervous system dysfunction that are symptoms of the disease are severely disabling but rarely fatal.

The disease is named for an epidemic of childhood arthritis occurring in Lyme, Connecticut, in 1975. Lyme disease has probably existed in Europe for many years and in North America since before the first European colonization, but it was not recognized as a distinct disease before 1975. Humans and domestic animals are only incidental hosts to the ticks, which normally infect wild mammals and birds. Deer are of particular concern as carriers of the ticks. The northeastern United States was greatly deforested during the eighteenth and nineteenth centuries, and deer and other wildlife populations declined dramatically. The more recent abandonment and reforestation of farms in New England has led to an increase in the deer and tick populations, with a resurgence of the associated joint and nervous system disease.

Nearly 300,000 cases of Lyme disease have been reported in the United States since 1982 and over 20,000 new cases are reported each year. Although the disease is most common in the northeastern United States, it is relatively rare in Canada. In the United States, scattered cases have been reported in the north central

states, along the West Coast, and scattered throughout the eastern, southeastern, and central states.

Early manifestations of the disease include flulike symptoms, with a localized skin rash. If untreated, the bacterium can spread to the nervous system, heart, and joints within a few weeks to months. A human vaccine against Lyme disease is currently being used for high-risk individuals.

Suppurative (pus-forming) arthritis may result from a number of infectious agents. These joint infections may be transferred from another infected site in the body or may be systemic (i.e., throughout the body). Usually, only one joint, normally, one of the larger joints, is affected, and the course of suppurative arthritis, if treated early, is transitory. With prolonged infection, however, the articular surfaces may degenerate. **Tuberculous arthritis** can occur as a secondary infection from pulmonary tuberculosis and is more damaging than typical suppurative arthritis. It usually affects the spine or large joints and causes ulceration of the articular cartilages and even erosion of the underlying bone. Transient arthritis of multiple joints is a common symptom of rheumatic fever, but permanent damage seldom occurs in joints with this disorder.

GOUT

Gout is a group of metabolic disorders involving joints. These disorders are largely idiopathic

(of unknown cause), although some cases of gout seem to be familial (occur in families and therefore are probably genetic). Gout is more common in males than in females. The ultimate problem in gout patients is an increase in **uric acid** in the blood because of too much synthesis or decreased removal through the kidneys. The limited solubility of uric acid salts in the body results in the precipitation of **monosodium urate crystals** in various tissues, including the kidneys and joint capsules.

The earliest symptom of gout is transient arthritis resulting from urate crystal accumulation in a joint, causing irritation of the synovial membrane. This irritation can ultimately lead to an inflammatory response in the joints, and both the crystal deposition and the inflammation can become chronic. This condition is called **gouty arthritis**. Normally, only one or two joints are affected. The most commonly affected joints (85% of the cases) are the base of the **great toe** and other foot and leg joints to a lesser extent. Any joint may ultimately be involved, and damage to the kidneys from crystal formation occurs in almost all advanced cases. **Kidney failure** may occur in untreated cases. With modern medications, these complications seldom occur. Weight control and reduced alcohol consumption can help prevent gout.

Pseudogout is a disorder that causes pain and swelling similar to that seen in gout, but it is characterized by calcium hypophosphate crystal deposits in joints.

HALLUX VALGUS AND BUNION

In people who wear pointed shoes, the great toe can be deformed and displaced laterally, a condition called **hallux valgus** (hal' tks val' gŭs). Bunions are often associated with hallux valgus. A **bunion** is a bursitis that develops over the first metatarsophalangeal joint because of pressure and rubbing by shoes.

JOINT REPLACEMENT

As a result of recent advancements in biomedical technology, many joints of the body can now be replaced by artificial joints. Joint replacement, called **arthroplasty**, was first developed in the late 1950s. One of the major reasons for its use is to eliminate unbearable pain in patients near ages 55 to 60 with joint disorders. Osteoarthritis is the leading disease requiring joint replacement and accounts for two-thirds of the patients. Rheumatoid arthri-

tis accounts for more than half of the remaining cases.

The major objectives in the design of joint prostheses (artificial replacements) include the development of stable articulations, low friction, solid fixation to the bone, and normal range of motion. Synthetic replacement materials are being designed by biomedical engineers to accomplish these objectives. Prosthetic joints usually are composed of metal, such as stainless steel, titanium alloys, or cobalt-chrome alloys, in combination with modern plastics, such as high-density polyethylene, silastic, or elastomer.

The bone of the articular area is removed on one side (a procedure called **hemireplacement**) or both sides (**total replacement**) of the joint, and the artificial articular areas are glued to the bone with a synthetic adhesive, such as methylmethacrylate. The smooth metal surface rubbing against the

smooth plastic surface provides a low-friction contact, with a range of movement that depends on the design.

The success of joint replacement depends on the joint being replaced, the age and condition of the patient, the state of the technology, and the definition of success. Success is usually defined as minimizing pain while maintaining movement. Most reports are based on examinations of patients 2–10 years after joint replacement. The technology is improving constantly, so current reports do not adequately reflect the effect of the most recent improvements. Still, reports indicate a success rate of 80%–90% in hip replacements and 60% or more in ankle and elbow replacements. The major reason for the failure of prosthetic joints is loosening of the artificial joint from the bone to which it is attached. New prostheses with porous surfaces help overcome this problem.