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Prompt Treatment May Minimize Knee Problems and Their Interference With Flight Duties — and Daily Routines

Knee injuries and diseases such as arthritis of the knee are common. Treatments may be as simple as resting or modifying exercise routines or as complex as a surgical replacement of the knee.

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The knees are the largest and heaviest compound joints[1] in the body. They carry nearly half the body's weight, provide stable support and function not unlike hinges to allow the legs to bend and straighten.

Knees are injured more often than any other joint[2] and also are susceptible to damage resulting from disease.

Especially as they reach middle age, pilots and other crewmembers who regularly participate in sports and other physical activities that place stress on the knees are subject to a multitude of knee problems. In most circumstances — as long as the knee's range of motion is not significantly restricted and medication does not impair mental functioning — pilots can continue flying even with knee problems. In other situations, they typically can resume their flight duties after recovery from corrective surgery.

The knee is a joint comprising four bones: the femur (thighbone), the tibia (shinbone), the fibula (the outer bone between the knee and the ankle) and the patella (kneecap; Figure 1, page 2). The surfaces of the femur and the tibia, which are subject to hundreds of pounds of force, are cushioned at their ends by cartilage; the cartilage is hard but also elastic and slippery, and helps to reduce friction that occurs as the knee moves. Where the cartilage surfaces press against one another in the joint, the joint tissue (synovial tissue) secretes a fluid (synovial fluid) that lubricates the joint. The patella is an oval-shaped bone enclosed within the large tendon that runs from the quadriceps (thigh muscles) to the tibia. The patella helps conduct the thigh-muscle forces across the knee.

Between the femur and the tibia are two pads of cartilage (connective-tissue disks, or menisci; each one is called a meniscus) that are side by side. These menisci help absorb physical shocks to the body during walking or running. Fluid-filled sacs (bursas) within the knee also help cushion the joint when tendons, ligaments or skin rub across bones. Two strong ligaments (the anterior cruciate ligament [ACL] and the posterior cruciate ligament [PCL]) cross one another near the center of the knee and help to stabilize the joint. (Cruciate means "across.") Two collateral ligaments are located at the sides of the knees; the medial collateral ligament [MCL] is on the inside and connects the femur and the tibia; the lateral collateral ligament [LCL] is on the outside and connects the femur to the fibula.

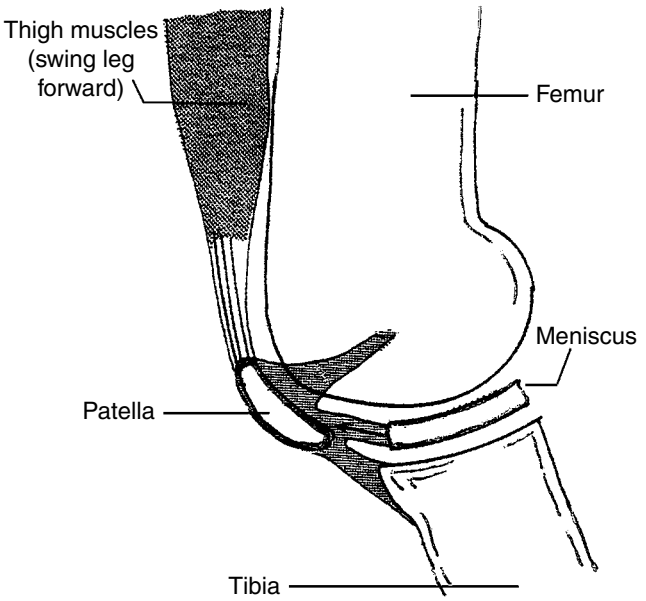

Figure 1

Knee problems are the most common reason for visits to orthopedic surgeons. For example, in the United States in 2001, 18.3 million visits to physicians' offices were attributed to knee problems.[3]

Physicians diagnose knee problems — regardless of whether the problems result from injury or disease — with a physical examination, a review of the patient's medical history, and X-rays. Sometimes, a diagnosis also requires the use of other imaging techniques, blood tests, biopsies or arthroscopy, a procedure in which a small fiber-optic viewing instrument called an arthroscope is inserted through a small incision into the interior of a knee. The arthroscope transmits the image of the knee to a monitor, enabling a surgeon to examine the joint.

Osteoarthritis Can Cause Pain, Stiffness

One of the most common problems affecting the knees is osteoarthritis (degenerative joint disease), in which the surface layer of the cartilage is worn away. This causes the bones beneath the cartilage to rub against each other; pain, swelling and restricted joint movement may result. (Osteoarthritis also can occur in other joints, most frequently in the fingers and thumbs, neck, lower back and hips.) As the disease progresses, small growths called bone spurs (osteophytes) sometimes grow on the edges of the affected joint and may break off inside the joint, causing additional pain.

Osteoarthritis occurs most frequently among people who are middle-aged and older; younger people also develop osteoarthritis, usually as a result of injury to the joint. There is no known cause of osteoarthritis, but medical specialists have identified a combination of factors that place people at risk of the disease, including increasing age, injuring a joint, being overweight and placing stress on the joint during work and/or recreation. Often, an individual has osteoarthritis in only one knee.

Osteoarthritis can cause a knee to be stiff, swollen and painful; walking, climbing stairs and performing simple tasks — such as standing after sitting in a chair — can be difficult. Often, an individual with osteoarthritis of the knee experiences stiffness in the knee after awakening; the stiffness decreases with movement.

People with osteoarthritis of the knee often are advised to lose excess weight, to wear well-cushioned shoes, to perform exercises to strengthen the knee and increase the movement of the joint, and to observe regularly scheduled rest periods to prevent overexertion and the resulting pain. Sometimes, heat or cold may be applied to relieve pain; cold also sometimes helps alleviate swelling.

Osteoarthritis typically is treated with anti-pain medication, including acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs) such as aspirin or ibuprofen. Research shows that acetaminophen is less likely than NSAIDs to result in long-term side effects, including stomach irritation or impaired kidney function. Side effects are most likely in people who use NSAIDs for a long period of time. NSAIDs should not be taken in addition to many other types of medication because they interfere with the body's proper use of those medications.[4] Nevertheless, acetaminophen should not be used by people with liver disease, those who consume large amounts of alcohol or those who take blood-thinning medications or NSAIDS.

In recent years, new types of NSAIDs have been developed with fewer gastrointestinal side effects. Some of these medications may not have the additional benefit of providing protection against heart disease, however.[5]

In some cases, medications other than NSAIDs are prescribed, including topical pain-relievers, which are applied to the skin in creams or sprays; corticosteroids (anti-inflammatory hormones) such as prednisone, which is taken by mouth, and other related medications that are injected, inhaled or applied to the skin; or hyaluronic acid (a component of the joint that facilitates its lubrication), which is injected into the affected joints. Narcotic painkillers are prescribed rarely.

Physicians sometimes recommend glucosamine or chondroitin sulfate, taken individually or in combination. These are nutritional supplements that some medical researchers say can alleviate the pain of osteoarthritis and can prevent further damage; other specialists disagree. (Glucosamine and chondroitin occur naturally in the human body; in

supplement form, glucosamine is derived from the shells of shellfish, and chondroitin is derived from the cartilage of cattle or sharks.)

A research report published in the British medical journal *The Lancet* in 2001 — based on a three-year Belgian study of 206 people with osteoarthritis of the knee — said that symptoms improved after treatment with 1,500 milligrams a day of glucosamine sulfate and that measurements showed no significant loss of joint space in the knee (that is, no significant loss of cartilage within the joint).[6]

Glucosamine Considered Most Helpful For Mild to Moderate Osteoarthritis

Arthritis Care, the largest U.K. volunteer organization working with people with arthritis, said that glucosamine is believed to be most beneficial for people whose osteoarthritis is not severe, or for people who have experienced cartilage damage in only one joint or two joints, including those with sports injuries.[7]

Short-term side effects of glucosamine may include nausea. Long-term side effects have not been studied. Some specialists have cautioned people with shellfish allergies to avoid glucosamine; other specialists say that, because glucosamine is derived from shells, it contains no allergenic components. Specialists also have said that people with diabetes should monitor their blood sugar levels more frequently when taking glucosamine.

Some medical specialists say that short-term side effects of chondroitin may include mild digestive problems. Long-term side effects still are being studied. Specialists say that people who take both chondroitin and blood-thinning medications should check their blood-clotting time frequently because the combination of the two medications may cause bleeding.

Other studies, including at least one other major study, by the U.S. National Institutes of Health (NIH), are in progress to evaluate the effects of both glucosamine and chondroitin.[8]

Other alternative supplements, including s-adenosylmethionine (SAMe), sometimes are administered to relieve the pain and inflammation of osteoarthritis. Reports by researchers in Germany, Italy and the United States have said that SAMe was as effective against osteoarthritis as some NSAIDs and that — unlike many NSAIDs — it did not have side effects involving the digestive system.[9]

In some cases, when medications and/or nutritional supplements are not adequate to assist in repairing damage to the knee, one of the following types of surgery may be required:[10]

- Arthroscopic surgery, in which a surgeon inserts an arthroscope and small surgical instruments through small incisions in the knee to remove or repair damaged tissue. Arthroscopic surgery is most often performed on people between the ages of 20 and 60 who have symptoms including swelling, pain, a "catching" sensation (a feeling that something inside the knee momentarily interferes with normal movement) and/or a feeling that the knee is unable to support weight, and who have received little improvement or no improvement from use of medication and other less-invasive treatments. Many patients resume most of their normal physical activities about six weeks to eight weeks after the procedure;

- Osteotomy, in which a surgeon reshapes the tibia or the femur and repositions the knee. Osteotomy is most often performed on people younger than age 60 who are active and/or overweight and whose knee has a correctable deformity and no inflammation. The pain-relieving procedure also may delay the progression of osteoarthritis; nevertheless, if a total knee replacement eventually is required, the procedure can be more difficult after an osteotomy. Normal activities may be possible about three months to six months after the procedure;

- Unicompartmental knee arthroplasty, in which a surgeon removes damaged or diseased bone and replaces it with an implant (prosthesis). The procedure is most often performed on people older than age 60 who are relatively inactive and are not overweight; the knee must not be significantly inflamed, and there must be no damage to other compartments of the knee, no calcification of the knee cartilage and no dislocation of the knee. Normal activities typically are resumed more quickly than after an osteotomy or a total knee replacement; and,

- Total knee replacement, in which a surgeon removes damaged cartilage and damaged bone and replaces them with metal and plastic components. This procedure usually is performed on people whose knee pain is so severe that it interferes with walking and other daily activities and persists even during rest; on people with chronic inflammation and swelling of the knee, knee deformities, stiffness that prevents bending and straightening of the knee; and on people who have not obtained relief from medications or other treatments. Most total knee replacements are performed on people between the ages of 60 and 80, but pain and disability — not age — are the deciding factors in whether the procedure should be performed. Most normal activities can be resumed within three weeks to six weeks after surgery, but some physical activities, including running, contact sports and high-impact aerobics — should be avoided for the remainder of the patient's life. Less than 2 percent of patients experience serious complications, which most often include blood clots in the leg veins and knee joint infections.

Other, nontraditional treatments include acupuncture (inserting thin needles into the skin at specified points on the body to

relieve pain or treat illness). Specialists believe that the insertion of needles stimulates the release of the body's natural pain-relieving chemicals.

Folk remedies include wearing copper bracelets, taking mud baths and drinking herbal tea. The National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) at NIH said that although these remedies cause no harm, they sometimes are expensive and people who use them may delay seeking medical treatment.[11]

"To date, no scientific research shows these [remedies] to be helpful in treating osteoarthritis," NIAMS said.

Osteoarthritis Is Most Common Form of Arthritis

Osteoarthritis is the most common of about 100 forms of arthritis, some of which also can damage the knee:[12]

- Rheumatoid arthritis is an inflammation of a joint (usually the wrists, knuckles and small joints in the feet, but the knee also can be affected) that can destroy the cartilage. The cause of rheumatoid arthritis is unknown but may be an autoimmune response (an action in which the body's defenses react against its own tissues). In addition to inflammation, swelling and pain in a joint, symptoms also may include fever, decreased appetite and energy, and anemia. Treatment typically involves NSAIDs and other pain-relieving medications and anti-inflammatory medications, exercise and rest; surgery may be required in cases of joint damage;

- Post-traumatic arthritis is similar to osteoarthritis but develops after an injury to a joint — sometimes many years after the injury. Symptoms and treatment typically are the same as those of osteoarthritis;

- Gout is a form of arthritis caused by elevated blood levels of uric acid, a product generated by the metabolic activity of cells. Uric acid crystals may be deposited in a joint or the tissue surrounding a joint. The buildup of crystals causes pain, inflammation and swelling in the affected joint — usually the large joint of the big toe, although the knee and other joints also can be affected — that persist for five days to 10 days, followed by discomfort for as long as two weeks before all symptoms disappear. Left untreated, recurring attacks of gout may result in permanent damage to a joint or development of a form of chronic arthritis that includes the formation of uric acid crystals in hard lumps beneath the skin near joints, in the kidneys or in the skin on the ears.

  Attacks of gout are sudden and without warning and often occur at night. Gout is most likely among people who consume large amounts of alcohol (especially red wine or beer, some specialists say) or foods that are high in protein; and among those who have recently experienced an injury, illness, surgery or emotional stress.

  Treatment typically involves NSAIDs, prednisone or other medications to reduce joint inflammation, or injections of cortisone into the affected joint. Medications also can be prescribed to decrease the body's production of uric acid and increase its elimination from the body, thus lessening the risk of recurring attacks of gout or reducing their severity; and,

- Pseudogout (false gout) is caused by the formation of calcium pyrophosphate crystal deposits in a joint — typically a knee, ankle or wrist. Symptoms are similar to those of gout; treatment typically involves use of NSAIDs, prednisone or other anti-inflammatory medications.

The knees can be damaged by other diseases affecting the joints, including bursitis, an inflammation of a bursa resulting from overuse, stress or injury to the nearby joint — or by arthritis. Bursitis often affects a shoulder, elbow or hip but also can affect other joints, including a knee. Symptoms may include an ache or stiffness near the affected joint, an increase in pain when the joint is moved or pressure is applied, swelling or reddened skin. Treatment typically involves resting the affected joint, immobilizing the joint, applying cold to reduce swelling and administering NSAIDs. In some cases, a corticosteroid is injected into the sore bursa.

Torn Ligaments Are Among Most Common Knee Injuries

Many of the same treatments are administered for injuries to the knee, which cannot safely absorb heavy direct blows from the front, side or back as may occur in contact sports or in accidents (Figure 2, page 5). In an aviation workplace, such injuries may be caused by slips, trips and falls in airports and in or around aircraft.

Some of the most common knee injuries involve complete tears, partial tears and stretches of the knee ligaments.

The ACL, which prevents the tibia from sliding forward beneath the femur, can be injured a number of ways; often the ACL is torn when an individual changes direction quickly, slows after running, lands on the feet after jumping or receives a blow to the knee while playing a contact sport.

When the ACL tears, there might be a popping noise, and the knee might buckle; pain sometimes does not occur for several hours. Walking with an ACL injury can cause damage to the cartilage in the knee. Orthopedists recommend applying cold and elevating the injured knee above the level of the heart to limit swelling until a physician examines the injury.

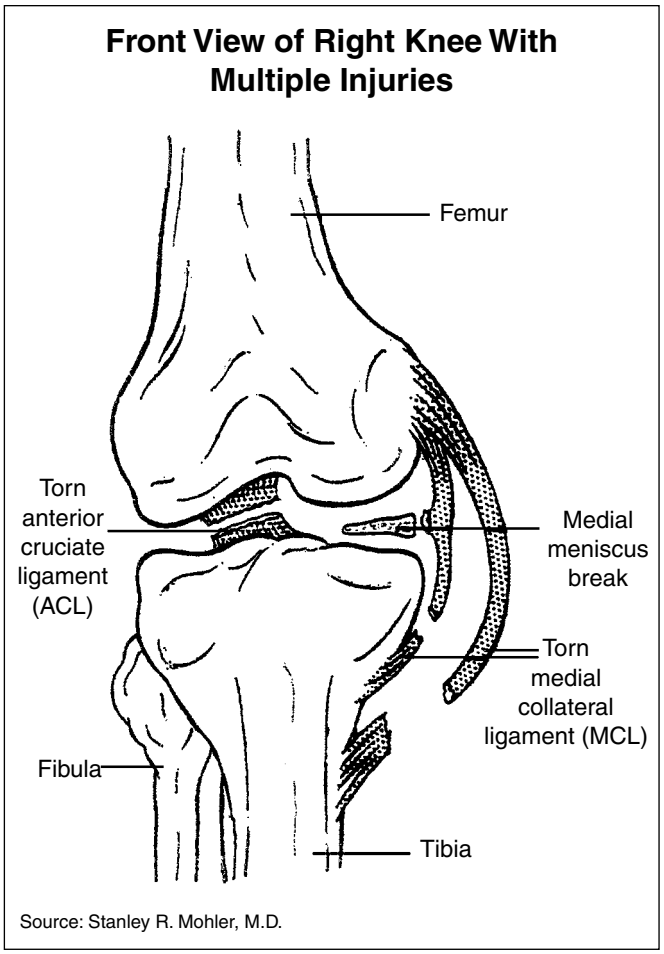

Figure 2

Treatment options vary, depending in part on whether the injury involves a stretch or partial tear of the ACL, or a complete tear. For less serious injuries, treatment may consist of prescribed exercises to strengthen the muscles supporting the knee. For a complete tear, arthroscopic surgery or open (traditional) surgery may be required to repair the ligament; in these cases, an orthopedic surgeon removes a strip of tendon, usually from the patient's knee or from the hamstring muscle (the muscle at the back of the thigh), passes the tendon through the inside of the knee and secures the tendon to the tibia and the femur. Recovery from surgery includes an exercise program to strengthen the muscles around the knee and restore full mobility of the joint.[13]

Injuries to the PCL — which are less frequent than ACL injuries — usually occur because the knee was hyperextended (overextended) or because of a blow to the front of the knee, such as a bent knee striking a dashboard in an automobile accident. As a result of the injury, the ends of the tibia and the femur rub against each other and may damage the cartilage and — eventually — may contribute to post-traumatic arthritis.

Symptoms of a PCL injury include swelling behind the knee, pain and instability of the knee. The injury can be treated by splinting the knee, applying cold, elevating the knee above the level of the heart and using NSAIDs to relieve pain. Physical activity should be limited until the swelling and pain are gone and the knee's range of motion is normal; then prescribed exercises may be required to strengthen the muscles around the knee. In the most serious cases, arthroscopic surgery or open surgery may be required to repair the damage.

Injuries to the MCL usually are caused by a blow to the outside of the knee. Symptoms include pain at the inside of the knee, swelling and instability of the knee. The injury is treated by applying cold, elevating the knee above the level of the heart, administering NSAIDs and limiting physical activity until pain and swelling are gone. Surgery usually is not required.

Injuries to the LCL, which are rare, are caused by pressure on the inside of the knee. Symptoms include pain at the outside of the knee, swelling and instability of the knee. Treatment is the same as treatment for an MCL injury; surgery usually is not required.

Twisting of the Knee Can Cause Torn Meniscus

Another common knee injury is a torn meniscus, which typically occurs when the knee has been twisted; nevertheless, some tears occur because the cartilage has become weak and thin as the person aged. A popping sound sometimes is heard when the tear occurs. Symptoms include stiffness, swelling, pain that may feel as though it is coming from the space between the bones and that becomes worse when pressure is applied to the joint, and a "catching" sensation in the knee as the leg moves.

Treatment of a meniscal tear begins with resting the knee, applying cold, donning a knee-immobilizer to limit the possibility of further injury and administering NSAIDs. In some cases, this is all that is required; other cases require arthroscopic surgery or open surgery.

In cases in which a meniscus has been seriously damaged, surgery may be required to remove it. Meniscus transplants sometimes are recommended for people younger than age 55 who are missing more than half of a meniscus, who are physically active and who do not have arthritis of the knee.[14]

Sometimes a small piece of cartilage or bone moves into the joint. This small piece is called a "joint mouse" or a "loose body" and can cause further damage within the joint, not unlike a broken tooth in a gearbox that damages the gears. In addition, small sandlike particles of cartilage form in the knee joint and can cause a crunching sound when the joint is moved and — eventually — can cause cartilage damage

and arthritis. This condition typically is corrected with arthroscopic surgery.

Sometimes cartilage accumulates at the edge of the knee — a process known as "lipping." This accumulation can cause pain and inflammation of the tissues around the joint. Arthroscopic surgery is the typical treatment.

A number of other problems can affect the knee, including the following:

- Patellofemoral pain (runner's knee) is characterized by pain under or around the front of the kneecap, where the kneecap and the femur connect, and stiffness of the knee. Causes include misalignment of the kneecap, overexertion, weak thigh muscles (or having quadriceps that are much stronger than hamstrings) and flat-footedness. Treatment includes resting the knee, applying cold, using an elastic bandage with a cutout for the kneecap, elevating the knee above the level of the heart and administering NSAIDs. When the pain subsides, the muscles around the knee should be strengthened with specific exercises before a resumption of the activity that led to runner's knee;

- Unstable kneecap occurs when the top of the kneecap slips out of the femoral groove (a notch in the femur), usually because the notch is uneven or shallow or because of a blow to the knee. Symptoms include buckling of the knee, pain that increases as activity increases, stiffness, cracking sounds and swelling. Treatment includes returning the kneecap to its proper place; sometimes the kneecap spontaneously returns to place, sometimes a physician applies pressure to force the return, and sometimes — when the kneecap is only partially out of place — exercises and/or braces are prescribed. Surgery may be required if the condition is chronic;

- Tendonitis occurs when a tendon becomes inflamed as a result of overuse during running, cycling or other activities. Tendonitis involving the patellar tendon (the tendon below the kneecap) also is called jumper's knee because the damage to the tendon often is a result of repeatedly jumping and then landing on the ground. The patellar tendon or the quadriceps tendon (the tendon above the knee) may rupture (tear) after repeated stress or when the muscles contract in trying to absorb the shock of a fall. Symptoms of tendonitis include tenderness where the patellar tendon and the bone meet and pain when running or jumping; symptoms of a ruptured tendon include pain and difficulty in bending, straightening or lifting the leg. Treatment of tendonitis includes resting and elevating the knee above the level of the heart, applying cold and administering NSAIDs. A total rupture of a tendon requires surgery; partial ruptures often heal with prescribed exercises;

- Iliotibial band syndrome is caused by repeated rubbing of a section of a tendon over the bone at the outside of the knee or — occasionally — by an injury to the knee. Symptoms include an ache at the outside of the knee during activity and a snapping sensation when the knee is bent and then straightened. Treatment usually includes a reduction in activity and prescribed exercises to stretch and strengthen the muscles; rarely, surgery is required;

- Avascular necrosis (osteonecrosis, aseptic necrosis or ischemic bone necrosis) involves the death of bone tissue and the collapse of the affected bone or joint surface as a result of a loss of blood supply to the bone. Any bone can be affected, but the illness most commonly affects the ends of the femur and other long bones. The disease usually affects people between the ages of 30 and 50 and typically is caused by an injury; by the use of some medications, including steroids and medications for blood coagulation disorders; or by excessive consumption of alcoholic beverages. Symptoms may not be apparent immediately, but as the disease progresses, pain develops around the affected bone and joint. Treatment typically includes administering NSAIDs, using crutches or limiting activities to reduce the weight being borne by the affected joint and performing prescribed exercises to improve the joint's range of motion. In some cases, surgery is required; and,

- Plica syndrome involves irritation of synovial plicae (remnants of tissue from fetal development) by overuse or injury to the knee. Normally, during fetal development, pouches of tissue combine to form one synovial cavity. When the process is incomplete, however, instead of the synovial cavity, there are four folds of synovial tissue within the knee. Symptoms include pain and swelling, a clicking sensation and weakness of the knee. Treatment typically includes use of NSAIDs, reduced activity, application of ice and an elastic bandage, and strengthening exercises. Sometimes, cortisone injections or surgery is required.

Precautions Can Prevent, Limit Knee Problems

Some damage to the knee is unavoidable, but the following precautions can be taken to limit the extent of many knee problems:[15]

- Strengthen the muscles that support the knee by riding a stationary bicycle, walking up stairs or up hills or performing a workout with weights;

- Wear shoes that fit properly and are in good condition. If orthotics (shoe inserts that help position the feet properly) and other protective sports gear are required, wear them;

- After awakening, extend and flex the leg around the knee joint. This helps lubricate the knee joint. (Similar movements can have the same effect on other joints, including the feet, ankles, hips, back, neck, shoulders and arms.);

- Before any exercise program or participation in sports activities, warm up the leg muscles by walking or by riding a stationary bicycle. Then perform exercises to stretch the quadriceps and hamstrings. These stretching exercises decrease tension on the tendons around the knee and relieve pressure on the knee; and,

- Avoid sudden changes in the intensity of exercise. Instead, gradually increase or decrease the intensity of the activity or its duration.

If a knee problem occurs, an early diagnosis may mean that conservative treatment, such as performing exercises to strengthen the muscles around the knee or modifying physical activities, will be all that is required to correct the problem. This solution may enable many pilots or other aircraft crewmembers to continue their flight duties — and most other elements of their daily routines — without interruption.♦

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Mohler received the 1998 Flight Safety Foundation Cecil A. Brownlow Publication Award for journalism that enhances aviation safety awareness.

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