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The Gymnast's Knee

Carrying the load

Few sporting activities capture the graceful movement of the human body like gymnastics and cheerleading do. These sports are generally safe; however, the potential exists for injury during both training and performance. Some injuries occur because the participant's bones have not yet fully developed, while others are due to overuse, poor technique, and a lack of warm-up.

The knee functions as the prime shock absorber of forces created by jumping and landing activities. Lower extremity impact forces incurred from a double backward somersault, for example, can result in peak vertical ground reaction forces of 8 to 14 times the body's weight.[1]

Absorbing these forces, however, can lead to microtrauma and acute trauma to the ligaments, tendons, and bones that make up the knee joint.

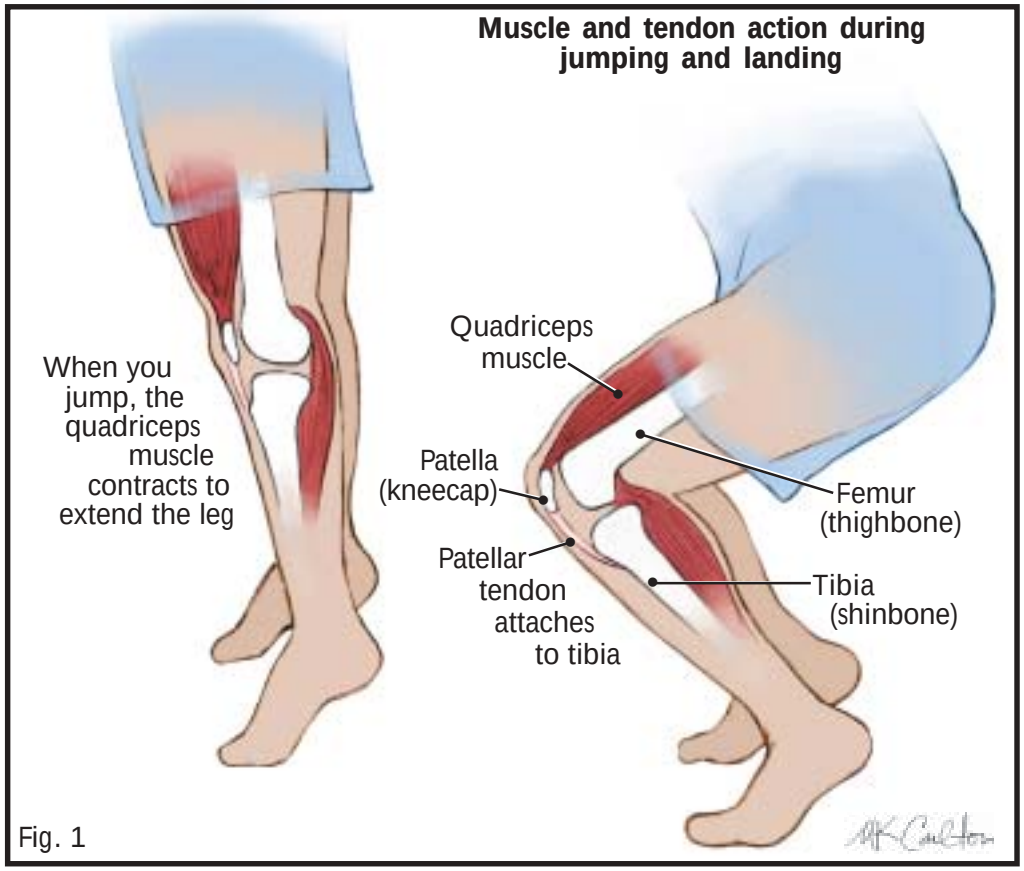

Fig. 1

By far, the most common knee injury involves the patella (kneecap), which represents approximately 60% of gymnastic and cheerleading knee disorders. These injuries range from tendinitis and inflammation of the growth plate, to patellar instability, to dislocation of the kneecap.

As an athlete runs, jumps, and lands, the power of these activities is largely generated by the quadriceps, the group of large muscles in front of the thigh (Fig.1). As the quadriceps contracts, it pulls on the patella, thereby transmitting force to the femur (thighbone). This creates a powerful extension force at the knee, which can be used to jump or to resist flexion (bending) of the knee during jumping and landing. The tendon that attaches the patella to the tibia (shinbone) delivers the power across the knee to the tibia. In a child, who is still growing, this tendon is attached to the

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tibia at the growth plate. Because the plate has not fully fused with the tibia, it is weak and can be injured by the repetitive pulling that occurs when a gymnast lands.

Osgood Schlatter's disease, which occurs in active growing children, usually occurs between ages 10 to 13. Children often present with pain and swelling at the tuberosity of the tibia (a bony projection below the kneecap) to which the patellar tendon attaches (Fig. 2).

Patellar tendinitis, or jumper's knee, is an inflammation of the patellar tendon. It most commonly occurs at the lower portion of the patella where the tendon attaches to the kneecap. Symptoms include pain, swelling, and varying degrees of hamstring tightness.

Rest, anti-inflammatory medication (such as ibuprofen or aspirin), and icing the area should help reduce the pain and swelling caused by Osgood Schlatter's disease and patellar tendinitis. Stretching the hamstring muscle also helps to reduce the strain on the knee. The athlete can return to practice and competition once the injury has healed and there is no more pain.

Patellar subluxation and **patellar dislocation** are two conditions in which there is a problem with the kneecap tracking in the groove on the end of the femur (Fig. 3). Subluxation refers to minor slippage or partial movement of the kneecap out of the femoral groove; a dislocation often occurs during an acute event that causes the kneecap to completely displace from its normal position in the femoral groove. Normally, soft tissues and muscles around the knee help to stabilize the kneecap allowing it to glide smoothly up and down. However, if the muscles are weak or the soft tissues are loose, the kneecap can slide out of the femoral groove causing pain and swelling. A dislocated patella can occur when an athlete lands off balance, forcing the patella out of position. Patellar subluxation and dislocations are usually treated nonoperatively with a patellar stabilizing brace, rest, and physical therapy to restore strength to the joint. Early treatment tends to minimize wear and tear on the joint, which can affect future sports participation and the development of arthritis later in life. Some athletes have structural problems with their knees, and despite proper conservative care they may require surgery.

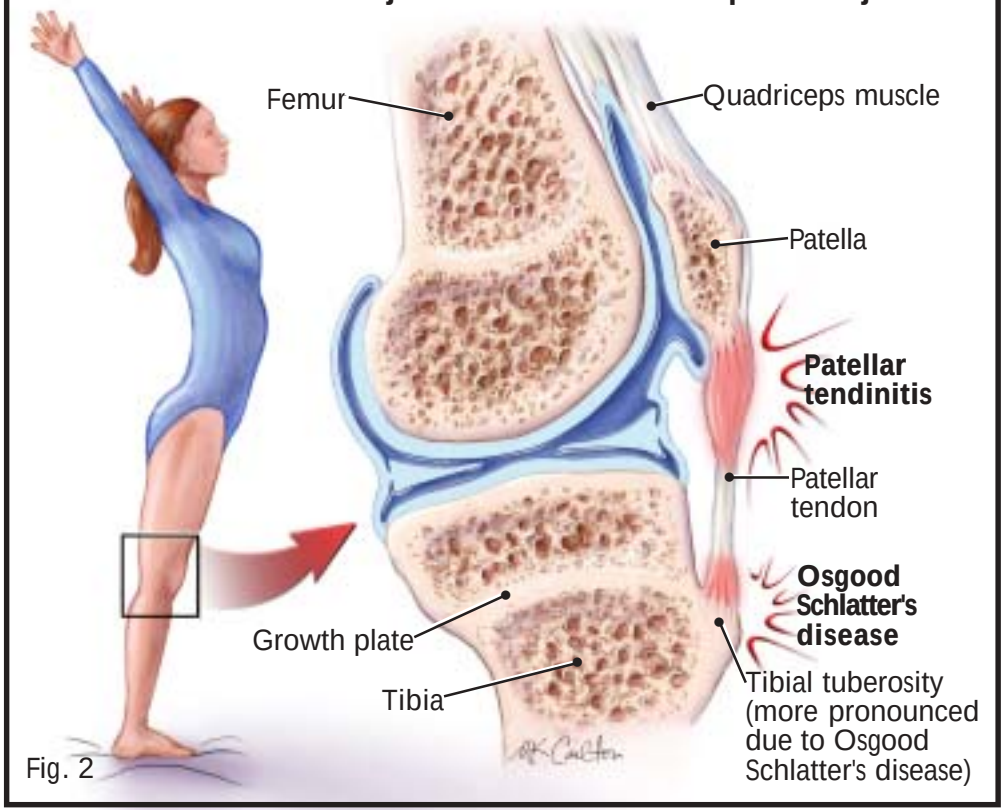


Fig. 2

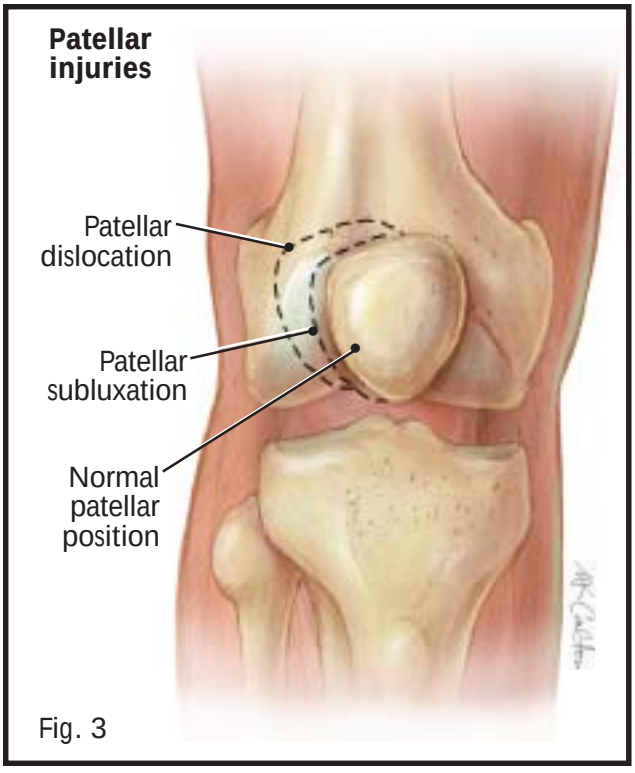


Fig. 3

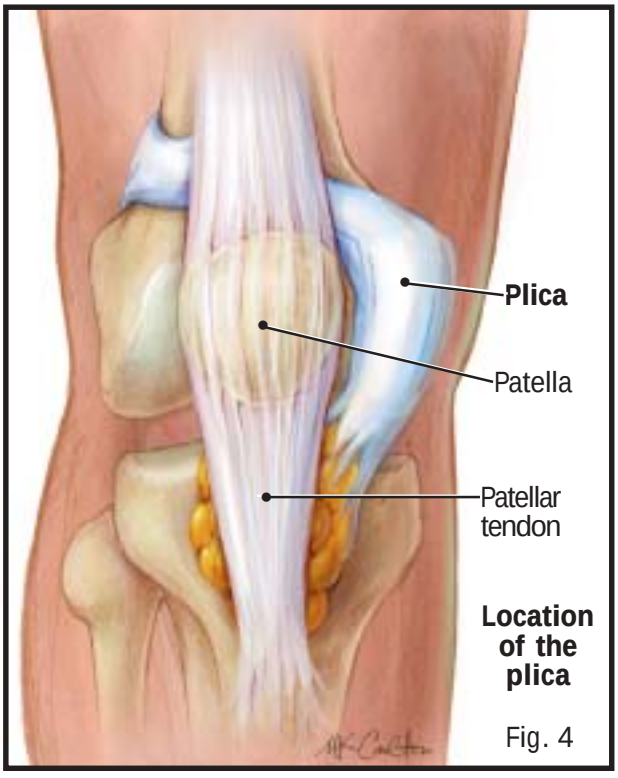
Plica syndrome, or inflammation of the fold, can also cause anterior knee pain and weakness in gymnasts and cheerleaders. The fold is a part of the soft tissue lining of the knee joint (Fig. 4, pg. 3). This horseshoe shaped band can become thick and cause snapping and popping sounds as the knee bends. Athletes may also complain of anterior knee pain when they sit with their knee flexed for too

long. The treatment involves rest and exercises to strengthen the muscles that keep the plica pulled back and stretching the hamstrings so the knee does not have to work as hard.

Injuries to the meniscus (cartilage) of the knee comprise approximately 20% of gymnastic and other athletic knee injuries. These injuries are usually the result of significant trauma. The meniscus is a good shock absorber that helps stabilize the knee. However, sudden, considerable force across the knee can produce a tear in the meniscus. These injuries should be evaluated by a sports medicine professional. Treatment may be either nonoperative or may require surgery to repair the damage. An MRI (magnetic resonance imaging) scan that shows bones, muscles, tendons, and ligaments often helps to diagnose the extent of these injuries.

Significant force can also produce damage to the ligaments of the knee. These injuries represent approximately 20% of all gymnastic and cheerleading knee injuries. The ligaments are bands of tissue on both the inside and the outside of the knee, and they are the major stabilizers of the knee. An off-balance landing or dismount can produce a major force on these bands, and one or more ligaments can tear either partially or completely. The anterior cruciate and the medial collateral ligaments are the most commonly injured, and the posterior cruciate and lateral collateral ligaments are injured less often. These injuries should be evaluated promptly and diagnosed so treatment can begin. Most athletes recover from these injuries with the appropriate treatment of bracing or surgery and, most often, return to their sport.

Treatment is important, not only to reduce the immediate swelling and discomfort, but also to reduce the risk of a more serious injury that can prevent the athlete's return to the sport. Early diagnosis and treatment helps reduce the time away from the sport, allowing for a quicker return to high performance activities. For this reason, "playing through the pain" should be avoided, but, more importantly, an injury to the knee can lead to arthritis later in life if it is not allowed to heal properly.



Location of the plica

Fig. 4

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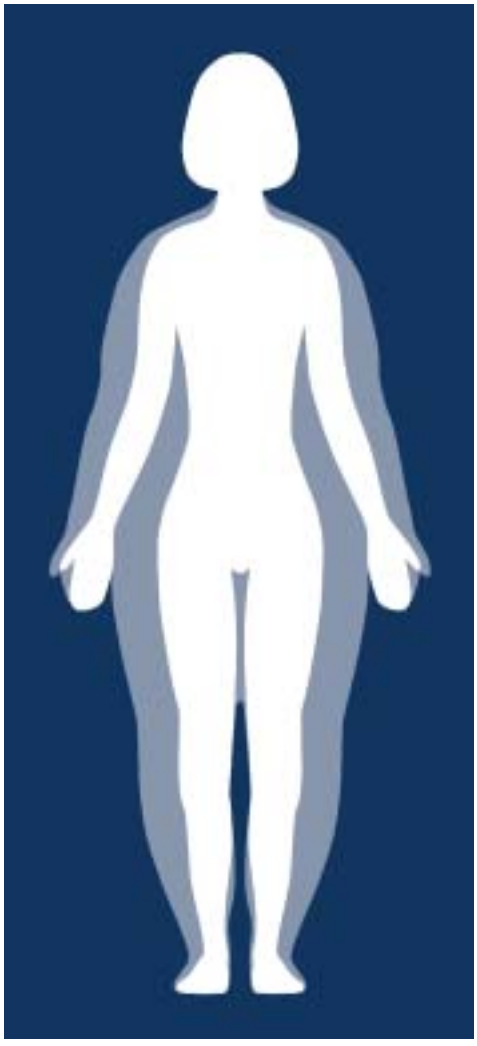
The Balancing Act

What's a girl to do?

Cheerleaders and gymnasts must be thin, right? Pressure from coaches, parents, and fashion models suggests the answer to this question be yes, yes, yes! However, young athletic women can and do develop serious health problems in their quest for an ideal body. The Female Athlete Triad, which consists of eating disorders, menstrual dysfunction, and osteoporosis (weak or frail bones), occurs as a result of inadequate nutrition and high-energy expenditure.

Eating disorders take many forms: refusing food (anorexia nervosa); cycles of overeating followed by vomiting (bulimia); fasting; and



excessive use of diet pills, water pills, and laxatives. These disorders occur in female athletes 10 times more often than in male athletes and lead to poor athletic performance. Without adequate calories, athletes cannot meet the demands of their sport. As a result of low calorie intake, athletes develop fatigue and weakness, which leads to decreased endurance and strength, a slower reaction time, and a reduced ability to concentrate.

Menstrual dysfunction refers to abnormal or absent menstrual cycles. The absence of 3 or more menstrual periods in a row is abnormal. Exercise does not cause menstrual abnormalities, rather, they are due to poor nutrition and low calorie intake with a high-energy demand.

Further, menstrual abnormalities lead to a decrease in production of estrogen, a hormone necessary for strong bones. Weak bones, or osteoporosis, can lead to stress fractures in young athletes and can cause serious fractures in older adults.

Limiting calories and food is not the way to maintain a lean, healthy body. Any competitive athlete knows that adequate nutrition is essential for strength, endurance, and best overall performance. So, what's a girl to do?

Remember, weight is not an accurate assessment of fitness or fatness. In fact, a lean, muscular body has an increased muscle mass. A lean body can only be achieved with a suitable weight-training program designed to increase the fitness level by increasing strength and endurance. A weight-training program will also enhance cardiovascular fitness, increase flexibility, and maintain a lower percent of body fat.

For the best results, circuit weight training should be done 4 times a week for 30 minutes. Circuit training works each of the major muscle groups: arms and shoulders, legs, back, and abdominal muscles. Each major muscle group exercise should be repeated 15 to 20 times, followed by a 30-second rest period before proceeding to the next exercise.

Before weight training, complete a 15-minute warm-up, such as jumping rope, running in place, or using a stationary bicycle. Then do stretching exercises for each muscle group. Always follow the weight-training program with a cool-down period. Be sure to schedule regular days off to allow the muscles to repair and rebuild. Dress in comfortable clothing that allows free movement, wear good athletic shoes, and drink plenty of water before, during, and after exercising.

Remember, crash diets, binge eating, and excessive exercise will not create a lean, healthy body. This can only be achieved with proper nutrition, adequate protein intake, and a consistent weight-training program that strengthens and tones muscles, while reducing total body fat.

For more information, check out the American Association of Orthopaedic Surgeons Web site at www.aaos.org.

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Wrist Problems for Gymnasts

In gymnastics, the wrists bear a tremendous amount of weight and are exposed to forces that well exceed normal daily activities. A gymnast's wrist is inclined to injuries because many routines (1) place the body's weight on the wrist while bending it backwards, and (2) often require fast, jolting movements to the wrists and hands. This results in injuries that are both acute, such as fractures, dislocations and sprains, and chronic (long-term). Most acute gymnastic injuries are treated like any other sport injuries, however, two chronic injuries, dorsal wrist impingement and distal radial stress fractures, require specific treatment.

Dorsal wrist impingement

Dorsal wrist impingement is the most common injury to a gymnast's wrist. The injury results from the repetitive combination of hyperextension (extending or straightening the joint beyond its normal range of motion) and axial loading, (placing force on the joint or bone) (Fig. 1). The injury occurs when the dorsal (back) edge of the radius impinges on (strikes) the wrist bones (Fig. 2, pg. 5). This injury often occurs during routines that include

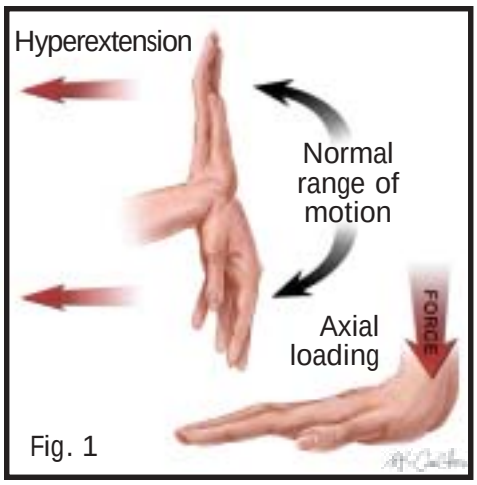

Fig. 1

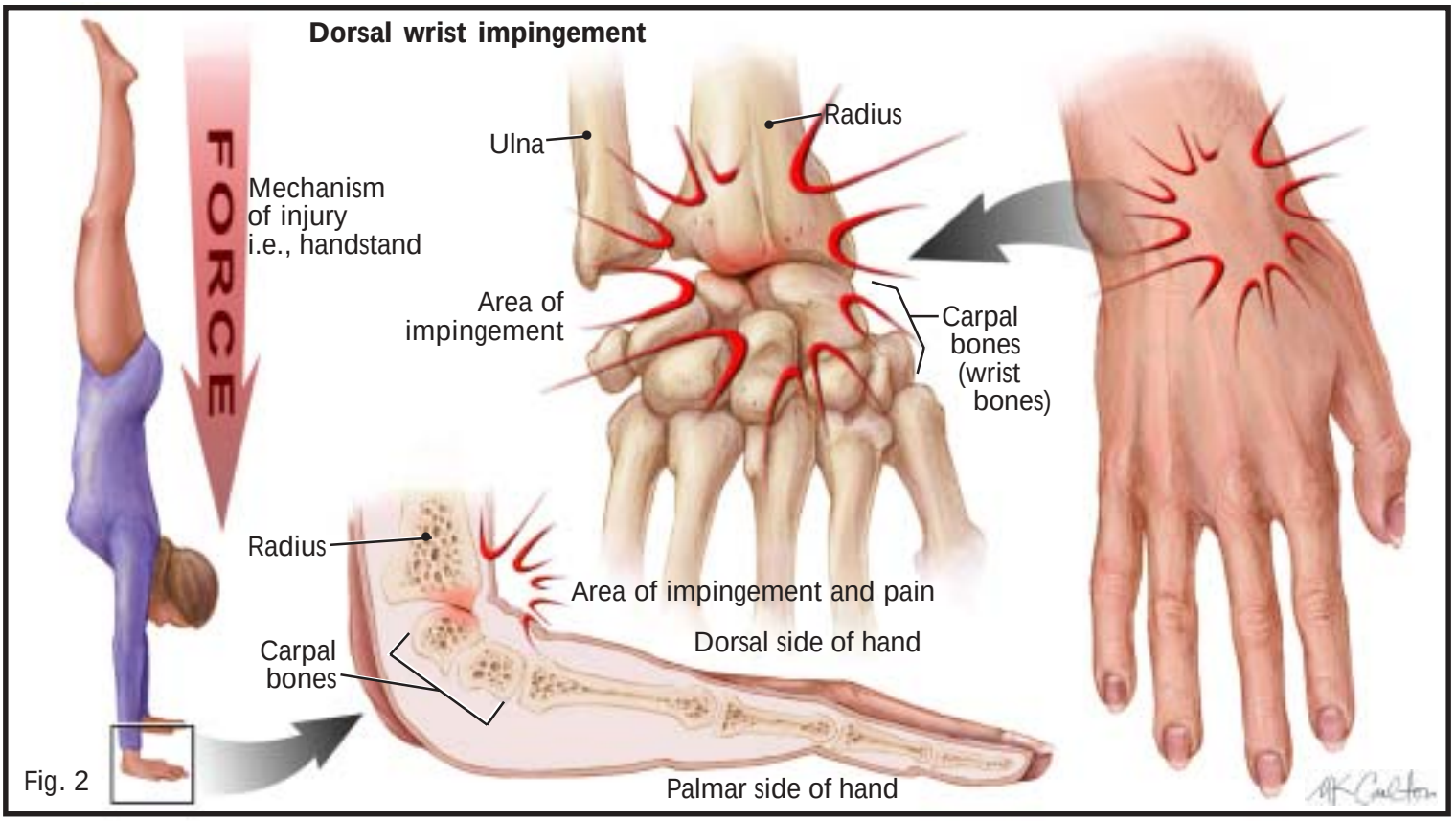

Fig. 2

walkovers and handsprings. On a vault or balance beam, the injury can intensify when the stance is held with the full weight of the body on the wrist, such as during a handstand. When injury occurs, the gymnast feels pain and tenderness on the backside of the wrist. The pain usually subsides after the routine has ended.

Treatment consists of complete rest from hyperextension and axial loading. A dorsal-wrist-block support or splint can be used to limit hyperextension, while icing plus anti-inflammatory medications, such as ibuprofen or aspirin, can help reduce swelling and pain. A stretching and strengthening program for the wrist and finger flexors should begin after the initial rest and rehabilitation phase has been completed. Gradual return to activity is allowed while continuing a stretching and strengthening program. If pain persists after rest and strengthening exercises, cortisone injections, and, occasionally, surgery may be required to correct the injury.

Distal radial stress fracture

Distal radial stress fractures (Fig. 3) are commonly associated with floor exercises and vaulting. High impact forces, incurred from a double backward somersault, for example, can cause compression on the wrist, causing small fractures (breaks) in the radius (the bone on the thumb side of the forearm). Pain and tenderness are often felt around the entire circumference of the radius just above the wrist. The pain is experienced at the onset of participation and progresses as activity continues.

X-rays play an important role in diagnosis of the injury. Because fractures can be seen on a x-ray, a physician can determine the severity of the injury and begin treatment immediately. The injury is often caused by repeated microtrauma (minor trauma) due to axial loading

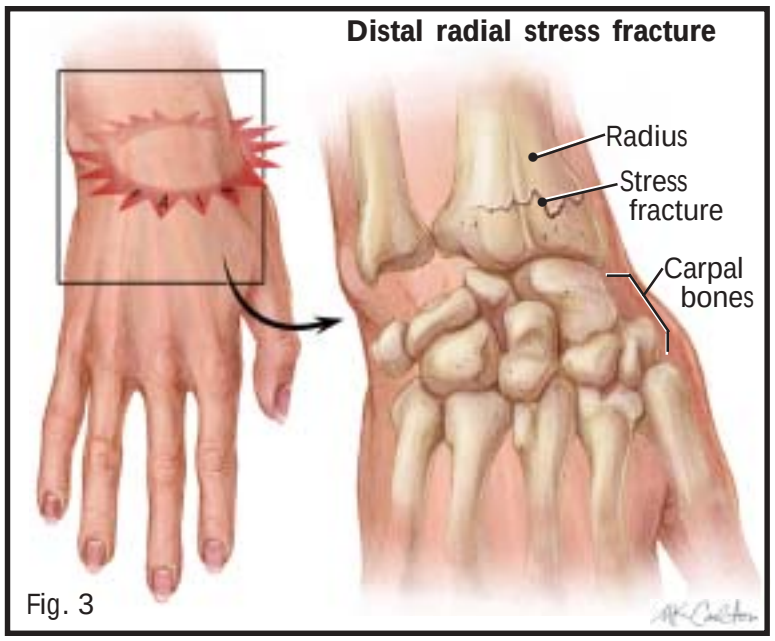

Fig. 3

and dorsiflexion (bending) of the wrist. This trauma can affect the growth plate of the radius and can result in decreased growth or length. This could, in affect, cause the radius and ulnar to grow to different lengths. Therefore, it is important to have the injury evaluated when the pain is first felt. Postponing a visit to a physician can lead to a more serious injury and a longer recovery time.

Treatment depends on the severity of the symptoms and the fracture. Resting and avoiding compressive loading routines is the mainstay of treatment. A splint or cast for immobilization may help. A gymnast may return to participation after full range of motion has returned and the pain and tenderness have subsided.

After returning to sport, it is important to monitor the wrists for recurring symptoms. Any recurrence of symptoms will require additional treatment, particularly, a rest period from participation. Surgery is not always necessary; however, severe injury and failure to see a physician right away often result in longer treatments, longer rest periods, and surgery.

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Weighing in with Nutrition

Gymnastics is a unique sport that demands enormous strength, flexibility, coordination, intense concentration, motivation, and dedication in order to excel. Experts often argue that gymnasts are stronger, pound for pound, than any other athlete. Nutrition plays a major role in a gymnast's growth and development, and has a direct effect on training and performance. For a gymnast to achieve a lean, muscular body, he or she must be devoted to exercise, training, and a well balanced diet.

Gymnastics is actually considered a speed event due to the high-intensity work. The fast-twitch muscle fibers of gymnasts have a limited ability to burn fat. To fuel activity, a gymnast's body relies on its reserves of glycogen (from carbohydrate foods). Primarily stored in the liver and muscle, glycogen constitutes the body's major carbohydrate reserve. When the body requires more energy for an intense workout it pulls it from its glycogen reserves.

An optimal diet for a gymnast is (1) rich in carbohydrates (60-65% of total calories), (2) includes an adequate supply of protein (12-15% of total calories), and (3) is low in fat (20-25% of total calories). However, the actual number of calories any athlete needs depends on his or her body composition (amount of fat and muscle) and body weight, as well as the intensity, duration, and frequency of the athlete's workouts.

Gymnasts and cheerleaders put extra demands on their bodies. More calories are used, more fluids are lost, and more stress is put on muscles, joints, and bones than in a sedentary person. Despite the demand, research shows that gymnasts between the ages of 9 and 22 years old eat from 20% to 50% less than their estimated caloric requirements.

Gymnasts often limit caloric intake to achieve a very lean body type. They tend to compare their body types with others and focus on how much they weigh. Weight becomes a measure of self-worth, causing some gymnasts to develop a "diet mentality." Proper nutrition, however, is critical to the athlete's performance and helps to prevent fatigue and injury.

An athlete concerned about his or her weight should see a health care provider. A young athlete cannot find his or her healthy weight by looking on a chart or keying-in height and weight into a body mass index (BMI) on the Internet. For years, height and weight charts were the standard, but now, more scientific-based methods are used. Often, a health care provider will use a combination of measurements and a combination of facts to determine a patient's healthy weight. Height and weight, gender, age, and activity level are major factors, but they are just the beginning. Other factors that help determine a healthy weight include a patient's percent of body fat, body frame size, and waist and hip circumference. With accurate information, the health care provider can help the athlete determine if more or less calorie intake, with more or less activity, is necessary to achieve a healthy weight.

It is important to remember that inadequate calorie intake can affect growth, development, and athletic performance. It can also lead to an eating disorder. The term *disordered eating* refers to individuals whose eating is somewhat out of control. Those who suffer from more serious problems such as anorexia nervosa or bulimia have eating disorders. Disordered eating behaviors range

from overeating and skipping meals to binging, fasting, and severe dieting. Disordered eating has been reported to occur in 15% to 62% of female athletes. Other factors that put athletes at risk for eating disorders are personality traits, such as perfectionism and obsessive behavior. Regardless of the cause, disordered eating is a serious problem that can result in nutrient deficiencies, dehydration, fatigue due to glycogen depletion, poor concentration, lack of motivation, delayed puberty, short stature, menstrual irregularities, poor bone health, and increased incidence of injuries.

The American College of Sports Medicine (ACSM) has defined a significant health problem, The Female Athlete Triad, which comprises 3 interrelated components: disordered eating, amenorrhea (absence of menstruation), and osteoporosis (thinning of the bones). Gymnasts have increased rates of disordered eating and amenorrhea. Any athlete, however, who is diagnosed with one component of the triad should be evaluated for the other components, as well.

Because there is no one cause for eating disorders, it is important to know the risk factors and recognize the symptoms. The earlier the problem is detected and treated, the less severe the long-term health problems will be. A registered dietitian, who is uniquely qualified by education, training, and experience can assist athletes with their specific nutritional requirements and can help to change disordered eating behaviors.

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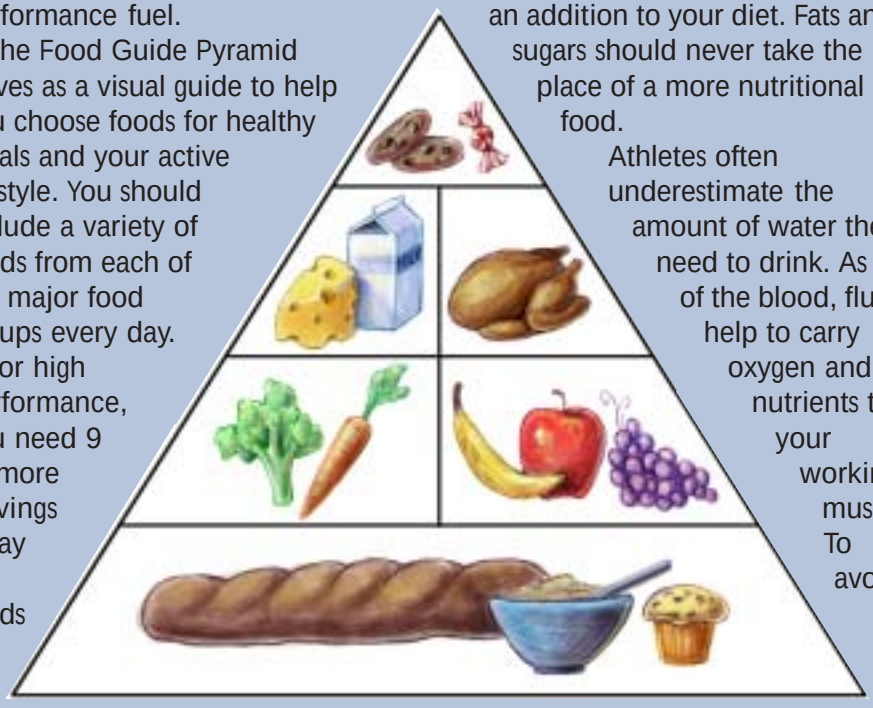
High Performance Fuel

As a gymnast, you spend hours in practice working on difficult moves, trying to achieve that perfect routine. But, like many gymnasts, you probably fall short when it comes to giving your muscles the right fuel. To maintain the stamina, strength, and endurance required of your sport, you need a diet that provides high performance fuel.

The Food Guide Pyramid serves as a visual guide to help you choose foods for healthy meals and your active lifestyle. You should include a variety of foods from each of the major food groups every day.

For high performance, you need 9 or more servings a day of foods rich in carbohydrates, such as grains, fruits, vegetables, and legumes (beans and peas). As a gymnast, you should also add colorful (red, orange, yellow, and green) foods: 3 servings of fruits and 4 servings of vegetables a day to improve your vitamin, antioxidant, and phytochemical (beneficial plant chemicals) intake.



Young athletes should consume 2 to 4 servings from the milk group daily because dairy foods are the best sources of dietary calcium.The average calcium intake among gymnasts is reported to be as low as 600 mg per day, which is well below the recommended intake of 1300 mg a day for 9- to 18-year-old girls. Although eating a high protein diet offers no added benefits for building muscles, 2 to 3 servings a day of lean meats, chicken, fish, beans, and eggs are recommended for providing the protein and iron you need. Foods containing a majority of calories from fat or sugars (at the top of the pyramid) are not eliminated, but they should be consumed only occasionally–as an addition to your diet. Fats and sugars should never take the place of a more nutritional food.

Athletes often underestimate the amount of water they need to drink. As part of the blood, fluids help to carry oxygen and nutrients to your working muscles. To avoid dehydration and heat related illness you should make a conscious effort to drink fluids before, during, and after physical activity.

For more information on nutrition and athletic performance, talk to a registered dietitian. Call the American Dietetic Association's (ADA) consumer nutrition hotline at 800-366-1655 or visit the ADA Web site at www.eatright.org to find a registered dietitian in your area.

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Kurt E. Jacobson, MD, received his undergraduate degree from Western Maryland College. He earned his medical degree at Tulane University School of Medicine and completed an orthopaedic residency at the University of Michigan Medical Center. He completed a sports medicine fellowship at The Hughston Clinic before joining our staff.

Dr. Jacobson is certified by the American Board of Orthopaedic Surgery. He holds membership in many professional medical societies, including the American Academy of Orthopaedic Surgeons, the Arthroscopy Association of North America, and the American Orthopaedic Society for Sports Medicine. He has been very involved in orthopaedic research and educational activities at the Hughston Sports Medicine Foundation.

In addition to general orthopaedics, Dr. Jacobson specialized in sports medicine and knee and ankle injuries. He serves as the head team physician for the Valdosta State University sports program and is involved in the athletic training and education program at Valdosta State University. He is also the head team physician for Andrew College.

Dr. Jacobson and his wife, Debby, have two children, Katie and Kevin. He enjoys golf, boating, and family activities.

The *Hughston Health Alert* is a quarterly publication of the Hughston Sports Medicine Foundation, Inc. The Foundation's mission is to help people of all ages attain the highest possible standards of musculoskeletal health, fitness, and athletic prowess. Information in the *Hughston Health Alert* reflects the experience and training of physicians at The Hughston Clinic, PC, of physical therapists and athletic trainers at Rehabilitation Services of Columbus, Inc., of physicians who trained as residents and fellows under the auspices of the Hughston Sports Medicine Foundation, Inc., and of research scientists and other professional staff at the Foundation. The information in the *Hughston Health Alert* is intended to supplement the advice of your personal physician and should not be relied on for the treatment of an individual's specific medical problems.

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