HUGHSTON SPORTS MEDICINE FOUNDATION, INC.

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Can your ski boot protect your leg?

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Ski Boots and Bindings

The great majority of snow skiing injuries involve the leg. Fractures of the bones of the lower leg (the tibia and fibula), as well as injuries to the knee ligaments, are common. This is not surprising when we consider that the sport entails sliding down a slick, inclined surface at speeds that can exceed 150 kilometers per hour. Constantly changing direction with a pair of lever arms (skis) attached to the feet can create tremendous torsional forces that the legs are not designed to accommodate. The foot is a relatively short lever compared to a ski and so does not transmit the large torsional forces to the leg that skis do. The attachment of the foot to the ski via boot and binding limits foot rotation and effectively attaches longer levers directly to the legs. A twisting force at the tip of a ski is multiplied by the long lever arm and can result in tibia and/or fibula fracture. Deceleration fractures at the boot top, or "boot top fractures," may occur as a result of bending loads on the tibia when the forward motion of the skier comes to an abrupt halt (Fig. 1).

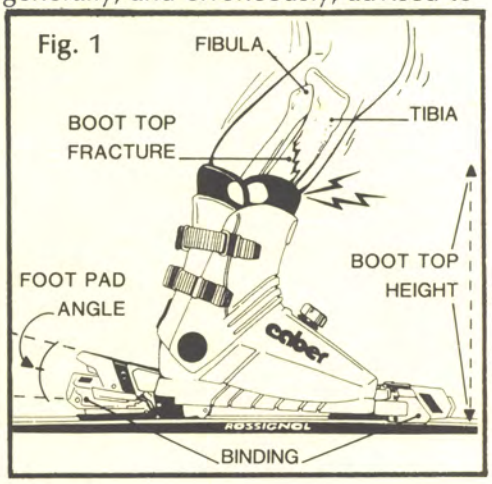
In an effort to reduce skiing injuries, technology is seeking to improve equipment. Of major importance in preventing ski accidents is the design of release bindings and ski boots.

Bindings

Release bindings are designed to release the boot from the ski when the load at the ski-boot junction exceeds a certain level. During normal skiing maneuvers, the boot must remain attached to the ski without inhibiting performance. If the binding releases at the proper time, the likelihood of a leg injury is greatly reduced. If, however, the binding fails to release, the foot is locked to the ski as if no safety device had been incorporated. The ideal ski binding would therefore be one that would consistently release before the load on the leg becomes great enough to produce a fracture or other injury. Proper calibration of the binding release is the key to this consistency.

Spiral fractures of the tibia are among the most serious ski injuries of the lower leg. These are produced by torsional forces acting on the tibia as the leg is twisted on the foot. Torsional loads delivered to the lower leg are resisted by both muscle and bone. As the muscles of the lower leg tense, they resist a portion of the torsional forces and decrease the deforming force "seen" by the bone. For safety's sake, however, when calibrating binding releases, one must assume that the bone "sees" all the torsional force because skiers are generally, and erroneously, advised to

Fig. 1



"go limp" during a fall. The maximum torsional force generated during an average skiing maneuver is approximately 25% of that required to produce a fracture. This allows a sizeable range for calibrating the release binding force. The ideal release binding would insure that the torque needed to cause boot release is consistent and is not dependent on body position or any ski load which is less than that required for release.

Boots

Ski boots are designed to limit side-to-side excursion of the ankle during edging and to transmit lower leg motion to the skis. (Unfortunately, boots also transmit ski motion to the lower leg.) A wide variety of ski boots are available, and each type has particular attributes and weaknesses. Boot top height, foot pad angle, boot stiffness, and mechanical neutral point (that point at which the leg imparts no anterior or posterior pressure to the boot) are all variables that contribute to the specific characteristics of a particular ski boot. The table summarizes pros and cons of these four variables.

Boot stiffness is especially significant. Stiffer boots are a means of affording greater control by allowing the skier to lean forward over the upper portion of the boot, but this added control does not come without some compromise of safety. Stiff boots transfer relatively greater forces from the skis to the legs much faster than do more flexible boots, so the likelihood of sustaining a deceleration fracture at the boot top is much greater in a stiffer ski boot.

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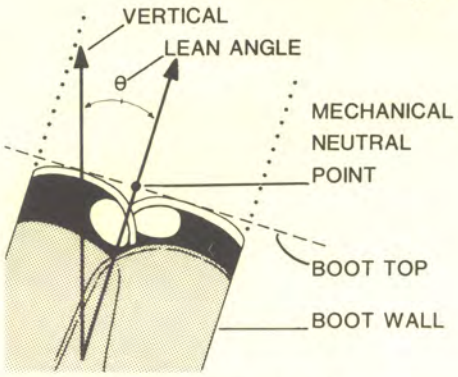
Fig. 2



Pros and Cons of Ski Boot Characteristics

	Pro	Con
Boot height	Greater height provides greater leverage for greater edge control.	Greater boot height leads to • knee ligament injuries. • difficulty ambulating. • increased strain on calf and thigh muscles.
Foot pad angle (a function of heel height)	High foot pad angle is suggested for • people with certain foot deformities. • competitive downhill racers.	High foot pad angle is ***not*** recommended for trick skiers.
Mechanical neutral point (Fig. 2)	Greater forward lean angle* allows • greater knee flexion. • more aggressive stance for more advanced skiers.	Greater forward lean angle* leads to • difficulty ambulating. • greater calf muscle strain, cramping, spasm, and fatigue.
Stiffness	Stiffer boots • afford experienced skiers greater edge control. • are recommended for experienced skiers using long skis on hard snow.	Stiffer boots • transmit force to the leg faster. • do not allow for the improper foot or leg motion of a beginner or intermediate. • are not recommended for freestyle skiing.

* The angle made by the mechanical neutral point measured from the vertical.

Your Aching Heel

"Painful heel syndrome" and the plantar fascia

Plantar fasciitis, or inflammation of the plantar fascia, is the chief cause of "painful heel syndrome" and involves people of all ages, from the relatively sedentary to the world class athlete. Fortunately, the consistent symptoms and clinical features of plantar fasciitis make this widespread problem readily identifiable and treatable.

The plantar fascia

The plantar fascia is actually a long ligament on the bottom of the foot connecting the tarsal bones of the hindfoot (calcaneus) to the metatarsals and phalanges of the forefoot (Fig. 1). Its primary function is to provide support for the arch during weightbearing. It also covers and protects nerves, blood vessels, and small muscles that lie next to it. Heel spurs, bony growth from the calcaneus, are not thought to be the primary cause of heel pain, although they are commonly associated with plantar fasciitis. It is worth noting that 10% to 15% of the normal population, with no evidence of heel problems, have similar spurs identifiable on x-ray.

Causes of plantar fasciitis

Overuse or athletic injuries are common causes of plantar fasciitis. It is usually described as a "stone bruise" to the heel when there is no history of trauma. More often, the individual has changed his or her activity, level of training, or perhaps footwear. These situations may precipitate injury to the plantar fascia or other tissues when stressed beyond their capacities. The first sign of plantar fasciitis may be burning, sharp heel pain on arising in the morning or after a period of rest. Symptoms may improve after a few steps, only to worsen with prolonged standing or exercise. Eventually, in order to compensate for their pain, patients may walk on their toes or adopt other abnormal gait patterns, resulting in other foot problems.

The examiner should attempt to locate the likely source of heel pain. Extending the toes places the plantar fascia on stretch and allows it to be felt and traced across the arch. The

most tender areas are typically at the third of the ligament nearest the heel. Occasionally, nerve irritation results in radiating pain or tenderness along the inside of the heel area as well.

Treatment

The treatment of plantar fasciitis is based on the understanding that the problem is self-limiting in most patients. If the injurious forces can be removed or reduced, the ligament will usually heal itself. While time is of concern to most athletes, patience is important. A full recovery may require weeks or even months.

After the problem has been identified, any recent changes in activities involving the feet should be evaluated. Differences in footwear, terrain, or intensity of workout may be factors that should be addressed during the healing phase and reapproached cautiously after symptoms resolve.

Shoe modifications should be directed toward reducing shock to the injured tissues. Soft soles should replace hard soles on all shoes. Orthotics (heel pads, shoe inserts, etc.) can be effective in redistributing weight from the injured area as well as balancing the foot to prevent stress that may perpetuate the injury. These changes are tricky at times and may require several modifications. Orthotic decisions are best made after consultation with a physician.

A diligent Achilles tendon stretching program can shorten the healing time and reduce recurrences of plantar fasciitis. This tendon attaches to the calcaneus and pulls against the direction of the plantar fascia ligament. If the Achilles tendon is tight, it may impose undue stress across the ligament, resulting in injury and pain.

Anti-inflammatory medicine may be helpful in reducing symptoms during the recovery period. Aspirin and ibuprofen (Advil, Nuprin, Medipren) can be purchased without a prescription and are proven effective if taken regularly three to four times daily. Other medicines with similar but more potent effects may be prescribed by a physician. Limited use of cortisone by injection can be effective in patients who don't respond to oral anti-inflammatory medicines.

Surgical lengthening of the plantar fascia ligament should rarely be necessary, and then only in recalcitrant cases. In some situations, surgery may also be needed to release tight tissues around the nerves that may be contributing to the symptoms. While lengthening of the plantar fascia is a relatively minor procedure that is 80% to 85% effective, like any surgery, it has potential complications. It is therefore recommended that nonoperative measures be pursued for at least a year; more than 90% of patients will respond within that time.

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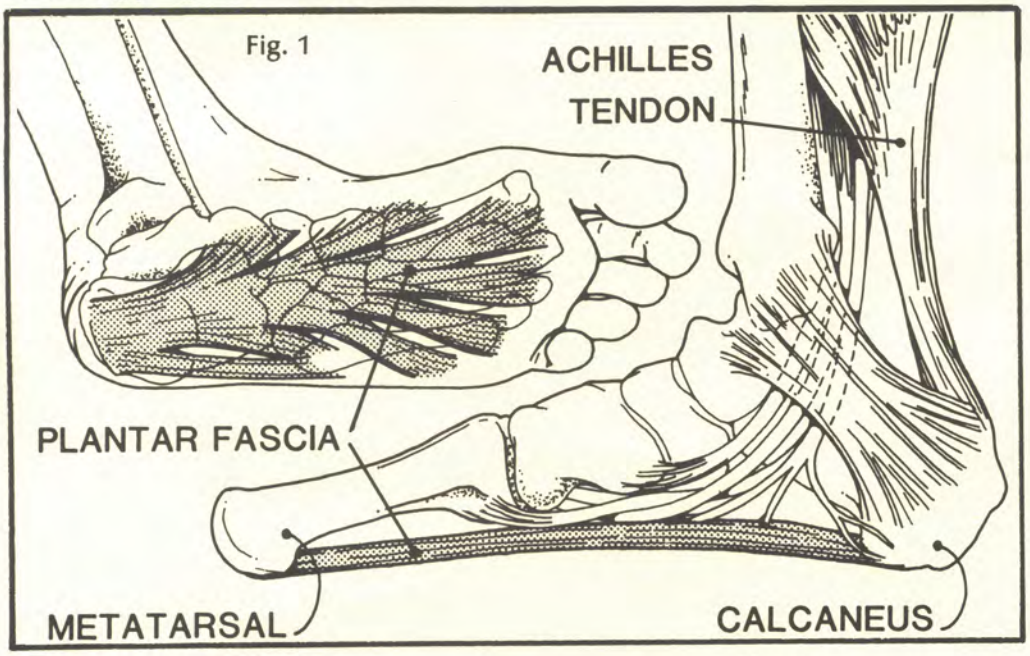

Photo by Y. Ehrhart

EQUIPMENT REVIEW

The Air Stirrup® Ankle Brace

Move over Ace bandages, ankle sprains may be more effectively supported by a cushion of thin air, or so claims Aircast, Inc., makers of the Air Stirrup® ankle brace. The brace consists of two molded plastic sides lined with pre-inflated air cells on its inner surface. These sides are connected by an adjustable heel pad. The brace is applied over a sock, attached with Velcro straps, and fits into a low-top, lace-up shoe (photo).

The brace is designed to limit instability and provide a constant low, undulating peak pressure with ankle motion. Aircast recommends its use as part of a program consisting of initial ice massage and elevation, early range of motion, progressive ambulation, and strengthening.

The Air Stirrup® has been the subject of several studies reported in the medical literature. Some investigators have found the Air Stirrup® effective in decreasing supination, or turning in of the foot. Others have found that the brace limited ankle motion significantly better than taping. Studies of several series of patients have recommended use of the Air Stirrup® for mild and moderate sprains.

Is the Air Stirrup® a replacement for surgery? The answer is controversial and depends largely on the individual patient, the specific demands on the ankle, and the severity of the sprain. It is a question best explored with your personal physician.

Is the Air Stirrup® for you? Experience suggests that it is an effective means of treating at least mild and moderately severe ankle sprains. Alternatives include casting, other types of braces, or simpler elastic supports. A specially fabricated high-top tennis shoe is also available. Discussion with your personal physician about your injury, your demands on the ankle, and the expense of the various treatment alternatives should guide your ultimate choice.

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Shin Splints

The pain of getting back in shape

With the winter season in full swing, and our excessive holiday behaviors now behind us, a lot of people are thinking hard (if not seriously) about getting back in shape. By virtue of the popularity of running, the condition known as "shin splints" has at least a familiar ring to many fitness enthusiasts. The term actually encompasses a variety of pain syndromes in the lower leg, and so runners (sometimes a bit difficult to comprehend anyway) may not be communicating in the same language when they discuss the affliction. We'll try to shed a little light on the confusion and develop a clearer concept of how to deal with the problem.

The definition

Most authorities agree that the definition of shin splints should be limited to pain or discomfort in the leg associated with overuse in training, especially the overuse that comes so easily after dis-use. Often, predisposing conditions cause the problem to develop; the most common are errors in training methods, abnormal anatomic factors, muscle inflexibility, faulty shoe design, improper running surfaces, and incorrect running biomechanics.

Shin splints occur in either the anterior (along the outside border of the shin) or the inner, posterior part of the lower leg (Fig. 1). In both cases, pain and tightness usually increase with running but may disappear with exercise, only to return several hours later. Repetitive stressful contraction of the muscles involved leads to inflammation at the tendinous site of the muscle attachment to the bone or in the periosteum (the connective tissue lining the outside of the bone), or even tearing in the muscles themselves. This repetitive "microtrauma" can be aggravated by sudden increases in training mileage (especially in a deconditioned athlete), running on hard or uneven surfaces, abnormal foot motion (for example, pronation, or turning the foot out), or an unusually high-arched foot.

The treatment

Ice application may reduce initial pain and swelling, and a compressive wrap added to this can also be helpful. Appropriate rest is really the mainstay of treatment; mileage should be reduced or even eliminated if pain is persistent and severe, with a gradual resumption of training activities. Gentle flexibility and strengthening exercises for the muscles involved should be added to the regimen. (See examples on page 5.) Predisposing conditions (abnormal mechanics, uneven running surfaces, shoes with poor motion control, etc.) should be sought out and eliminated. If these simple measures are not effective, the pain should certainly not be "run through" or ignored. More intensive treatment, such as anti-inflammatory medication or ultrasound, may be warranted.

Two other serious conditions that mimic the symptoms of shin splint syndrome may be present. The first, stress fracture of the lower leg bones, is relatively common and is often associated with the same predisposing conditions as shin splints. Treatment is more specifically directed at complete rest until healing occurs, because of the potential for worsening damage. The second condition, called "compartment syndrome," involves increased pressure in a compartment of the lower leg, usually anterior, that can compromise circulation and damage muscles and nerves. (A compartment is a muscle or muscle group enclosed in a fibrous sheet, the fascia; there are four compartments in the leg. See Fig. 2.) If a compartment syndrome is suspected, running should be discontinued and appropriate medical evaluation pursued.

Although surgical procedures have at times been necessary for recalcitrant cases of shin splints, most often the condition is readily treatable. Armed with an awareness of the predisposing conditions and the warning signs, the runner can usually head off this painful and frustrating affliction, making the task of getting back in shape a little more enjoyable.

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ANTERIOR SHIN SPLINT

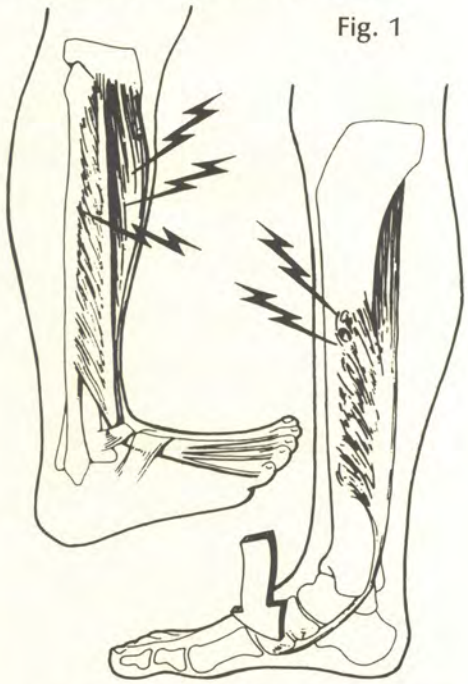


Fig. 1

POSTERIOR SHIN SPLINT

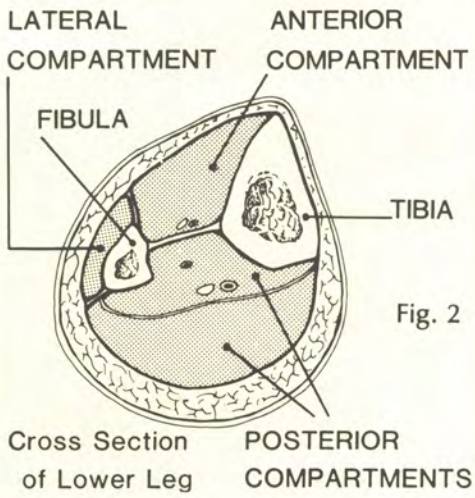
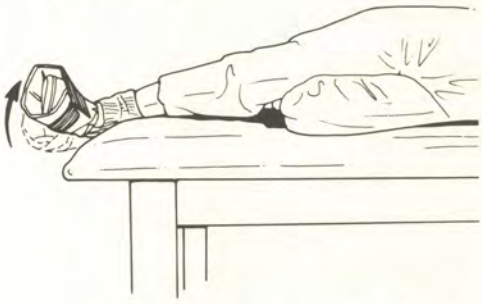


Fig. 2

These exercises are named for the muscle groups that are being flexed.

Dorsal flexion: Attach a weight on your forefoot. Sit so that your foot is off the floor. Pull your foot straight up, and hold for a three-count. Relax. Repeat 6 times.



Peroneal flexion: Attach a weight on your forefoot. Lie on your side on a table or bed so that the top foot is over the edge. Raise the little-toe side of your foot up toward the ceiling as high as possible. Hold for a three-count. Relax. Repeat 6 times.

Posterior tibialis flexion: Attach a weight on your forefoot. Lie on your side on a table or bed so that the bottom foot is over the edge. Raise the great-toe side of your foot up toward the ceiling as high as possible. Hold for a three-count. Relax. Repeat 6 times.

THE AGELESS ATHLETE

Exercising after a Heart Attack

How hard can you push your heart?

Over one million Americans will sustain a heart attack in 1989. In the medical jargon a heart attack is called "myocardial infarction." This means that some heart muscle tissue has died. There is no such thing as a "small" heart attack. If the infarction is limited in terms of amount of tissue, if there are no complications (heart rhythm problems, pump failure), and if heart muscle pain (angina) can be controlled, then the next step to consider is exercise.

Cardiac rehabilitation is just that–teaching the heart muscle how to work hard again. This process begins in the coronary care unit and continues throughout the hospital stay. It includes range of motion exercises for large joints (shoulders and hips) and chores for daily living (feeding and dressing yourself). A gentle treadmill stress test gives the physician vital information about your heart rate pattern (EKG), blood pressure, and pulse responses. You will learn how hard you can "push" your heart. For all practical purposes, this serves as an exercise "prescription" because it alerts you to the advisable limits for exertion.

Regardless of the severity of the "cardiac event," whether it is a simple heart attack or angina pectoris or even high blood pressure, take heed that your lifestyle needs changing: stop smoking, manage stress, lower cholesterol, control weight, limit salt intake, begin exercising.

Thinking about exercise

When considering exercise, remember:

Exercise taxes the heart. This is beneficial, but it must be slow and easy. Professional supervision can guide where you begin and how you progress.

Exercise is not meant to replace heart medicine, or vice versa. Medicine, exercise, diet, and rest complement each other.

Aerobic exercise--exercise involving large muscle groups over a prolonged period--is best for the heart. Walking, cycling, running, swimming, rowing, and cross-country skiing are aerobic. Lifting weights is not aerobic. Isometrics are not aerobic. Some activities, depending on how you engage in them, have no aerobic value; bowling, golf, and gardening can be as gentle as contract bridge. Exercise is meant to raise the heart rate, not just the eyebrows.

Getting started

You must realize what your goal should be, devise a reasonable plan, and then implement it.

The goal is sustained, comfortable exercise for 20 minutes three or four times a week. Many successful plans include as a goal raising your pulse to a predetermined "target" rate. The important thing is to do something that requires some effort for a third of an hour. (Walking and swinging the arms is one of the simplest ways to accomplish this.)

A workable plan considers pre-existing problems. If you already have knee arthritis, a brisk walk will only compound your frustration. A "floating walk" in a pool, or stationary cycling, or even arm cycling, may be better suited for you. Regardless of what you choose, you need a 10-minute warm-up period to stretch the areas you plan to exert the most. Slow, sustained, gentle stretching on a carpet is nice. Then, as your 20-minute exercise begins, ease into it, slowly at first, progressively picking up the pace.

Let common sense be your guide as you implement the plan. If *anything* hurts, then back off the intensity. Any cardiac symptoms (chest pain, light-headedness, profuse sweating, palpitations) are warnings that you may be doing "too much too soon." Execute your plan about the same time each day so it will be easier to remember. Exercise before meals, not after. After your work-out, you need a "cool-down" period, analogous to the warm-up period; repeat some slower stretching or slower walking. If any muscle soreness develops, it may be worthwhile to rub in some analgesic cream. Just remember that chest, shoulder, and neck soreness may represent low level angina that you should report to your physician.

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Computing Your Target Heart Rate

Method A

[220 - age] x 65% = target rate

Example: If you are 50 years old, your target heart rate during exercise is 102 beats per minute.

[220 - 50] × 0.65 = target rate

170 × 0.65 = 102 beats per minute

Method B

[([220 - age] - resting pulse) × 65%] + resting pulse = target rate

Example: If you are 50 years old and your resting pulse is 70 beats per minute, your target heart rate during exercise is 135 beats per minute.

[([220 - 50] - 70) × 0.65] + 70 = target rate

[(170 - 70) × 0.65] + 70 = target rate

[100 × 0.65] + 70 = target rate

65 + 70 = 135 beats per minute

The 40-Minute Work-Out

WARM UP	Slow, sustained, gentle stretching of muscle groups you will exert.	10 minutes
WORK OUT	Sustained, comfortable exercise that raises your pulse to your target rate and maintains it for the work-out period.	20 minutes
COOL DOWN	Slower stretching or walking, letting your pulse rate slow down gradually.	10 minutes

NUTRITION

Carbohydrate, Blood Sugar Level, and Exercise

Strategies for better control

Excessive dietary carbohydrate intake and a sedentary lifestyle make 25% of American adults overweight. Most of this excessive carbohydrate intake is in the form of concentrated sources of sugar, such as table sugar and foods prepared with it. These sources of carbohydrate contribute few other nutrients. On the other hand, the American diet contains a less than optimal level of the fibrous sources of carbohydrate associated with reduced risk of heart disease and cancer. The body needs carbohydrate, but what kind? And why?

Carbohydrate

Carbohydrate occurs in three forms: monosaccharides, disaccharides, and polysaccharides. Monosaccharides are the single-unit molecular structures that are sometimes called "simple sugars," glucose, fructose, and galactose. Cereals, fruits, and vegetables contain glucose, and honey and many "dietetic foods" contain fructose. Galactose is seldom found free in nature.

Disaccharides contain two linked monosaccharides. Fructose and glucose form the most common disaccharide, sucrose, or table sugar. Lactose, in milk, and maltose, in malt products and certain cereals, are made of glucose and galactose.

Polysaccharides, composed of three or more monosaccharides, are classified according to their source, plant or animal. Wheat, corn, and other grains contain the most abundant plant polysaccharides. Glycogen is a polysaccharide produced by humans and other animals from glucose.

Carbohydrate and blood sugar

Most carbohydrates, whether simple or complex, are easily digested and readily available for the body to use for energy. The end product of carbohydrate digestion is the simple sugar, glucose, called "blood sugar" when it is produced in this way. Depending on the body's energy needs, glucose is converted to glycogen and either stored in the liver or transported to the muscles. When carbohydrate intake exceeds energy demands, excess glucose is converted to fat and stored in adipose tissue.

Blood sugar level fluctuates depending on the time and composition of meals and snacks and on the intensity of exercise. Simple carbohydrates are digested quickly and reach the bloodstream faster than complex carbohydrates, raising the blood sugar level quickly. A mixed meal of carbohydrate, protein, and fat eaten together mitigates the rise in blood sugar level.

Small, frequent meals and snacks also have desirable effects on blood sugar level, and therefore on weight control, especially for people who don't get much exercise. Long periods between meals may promote less than desirable blood sugar levels in people with glucose intolerance; when blood sugar levels are lower than normal for a period of time, a fatiguing condition known as hypoglycemia may result.

Carbohydrate, blood sugar, and exercise

Because carbohydrate is an important source of energy, it is a critical nutrient for anyone who has high energy demands. Glucose in the blood and glycogen stored in the liver and muscle provide much of the fuel needed for physical performance. During exercise, the glycogen content of liver and muscles progressively decreases. Unless it is replaced, hypoglycemia and the accompanying fatigue may negatively affect performance.

An athlete's diet should be 60% to 70% carbohydrate. A high intake of complex carbohydrate in the form of whole grain products (breads, cereals, pasta) and fibrous foods (raw apples, strawberries, bananas, dried fruits, raw vegetables) is suggested. Between-meal snacks of similar foods may be needed to meet the carbohydrate requirement. Omit or limit most concentrated sugars, such as sugar-sweetened desserts and fruits, jellies, jams, syrups, and soft drinks.

Continued exercise may reduce blood sugar level too much. In competition lasting more than 2 hours, sustain blood sugar level by

sipping small amounts of dilute carbohydrate solutions every 15 to 20 minutes. Avoid high glucose drinks before or during exercise because they may stimulate insulin production that can drive the glucose inside the cells, leaving the blood sugar level low and actually reducing the energy available.

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Elbow Pain in Little League Players

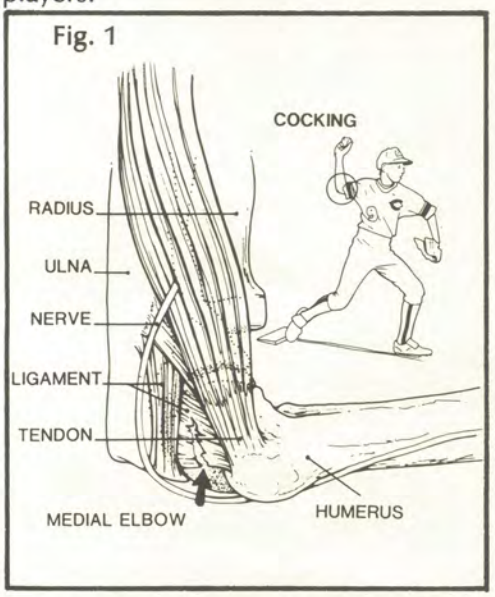
Beware of growth injuries!

The term "Little Leaguer's Elbow" was coined in 1960, to refer to a growth plate fracture in the elbow of adolescent pitchers. Today, the term refers to at least a dozen types of elbow injuries. Elbow pain in a growing youngster may be mild, or it may represent a dangerous injury. If the growth plate is fractured, for example, permanent deformity of the elbow may develop.

Problems with pitching

Three phases of pitching--cocking, acceleration, and follow-through--can cause elbow pain in Little League players.

Fig. 1



During the cocking phase (Fig. 1), tension is placed on the medial (inner) side of the elbow. Ligaments (connecting two bones), tendons (connecting muscle to bone), and the ulnar nerve can be stretched. Compression on the lateral (outer) side of the elbow can cause fractures.

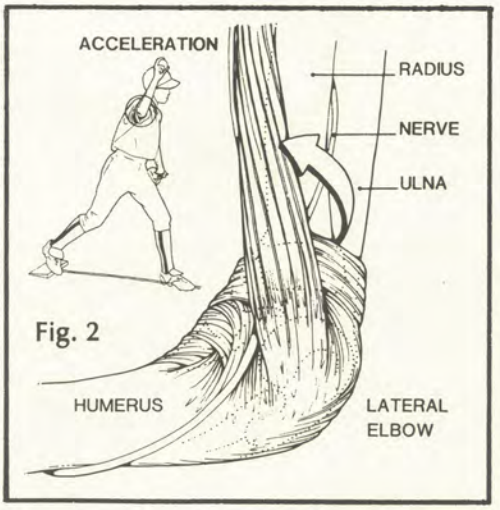


Fig. 2

During the acceleration phase (Fig. 2), rotation of the forearm can stretch ligaments and tendons on the lateral side of the elbow.

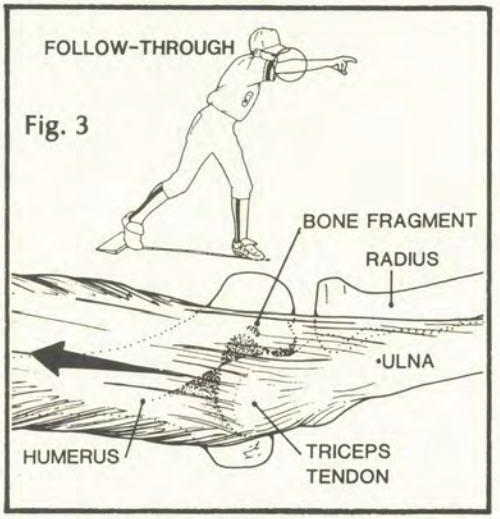


Fig. 3

During follow-through (Fig. 3), hyperextension of the elbow can cause injury to the end of the humerus (upper arm bone). Bone spurs can develop, or fragments may break off.

Prevention

Several steps can be followed to reduce the likelihood that Little League players will develop elbow pain.

- *Strengthen elbow muscles during the off-season as well as the playing season.* To strengthen inner elbow muscles, support the forearm on a table with the hand off the edge and the palm facing upward (Fig. 4, wrist curls). Hold a 1 to 10 pound weight (depending on age and strength). Bend the wrist downward and then curl it upward. Hold for a three-count. Repeat for 10 repetitions, for 3 sets, 3 times per week. To strengthen outer elbow muscles, do the same exercise but with the palm facing downward (Fig. 4, reverse wrist curls). Athletes with severe or prolonged elbow pain may need to have a physical therapist prescribe additional exercises.

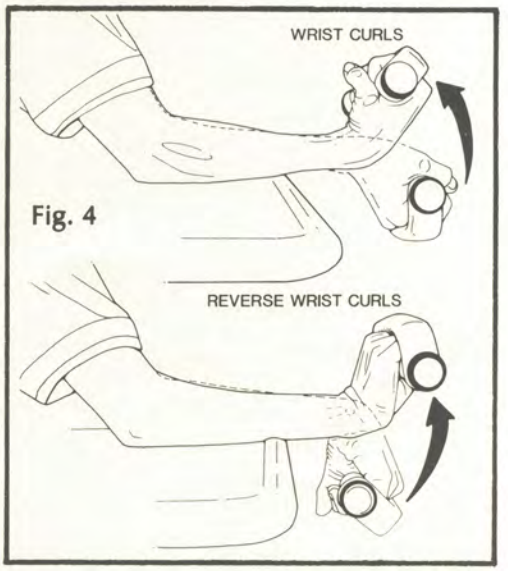


Fig. 4

- *Warm up before pitching.* All players should throw the ball for short distances for at least 15 minutes prior to starting a game or practice.
- *Prohibit curve ball pitching.*
- *Limit pitching.* Little League pitching rules about number of innings pitched per week and pitching rotation are designed to prevent elbow injuries.
- *Wear a neoprene sleeve.* For pitchers with mild elbow pain, an elastic wrap worn from the mid forearm to mid upper arm may keep the elbow warm and muscles loose. This may make muscle and tendon tears less likely, although it will not prevent severe injuries.
- *Seek medical advice early.* A Little League player should see a physician if elbow pain lasts more than several hours, if there is swelling, or if he is unable to move his elbow completely. It is important for growing youngsters with elbow pain to receive medical evaluation early because they may have an injury that could hinder elbow growth and strength if not treated promptly.

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FIRST AID For Elbow Injuries

For the unfortunate Little League player who acutely (suddenly) injures an elbow, the "**RICE**" plan helps relieve pain, control swelling, and begin the healing process:

1. **REST:**
   As soon as elbow pain develops, quit throwing. Do not stress the injured part for at least one day. Prolonged rest is not necessary for minor injuries (sprains, strains) and it may promote stiffness.
2. **ICE:**
   Put ice on the painful elbow as soon as possible. Wrap ice in a towel or plastic bag and apply it for 30 minutes. Move the ice every 5 minutes to prevent frostbite. Repeat 5 times per day for the first 72 hours.
3. **COMPRESSION:**
   Wrap an elastic bandage around the injured elbow. Start wrapping below and work up to push excess fluid out of the swollen area. If fingers become swollen or blue, loosen the bandage. Wear the wrap until swelling goes away.
4. **ELEVATION:**
   Elevating the elbow above the level of the heart helps drain excess fluid from the injured area. Lie down and prop the elbow on pillows.

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CALENDAR

Chattahoochee Valley Arthritis Club meets the first Thursday of every month at 7:00 p.m. at the Hughston Sports Medicine Foundation.

Watch for announcements about this quarter's ***Ageless Athlete*** program!

Hughston Health Alert

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