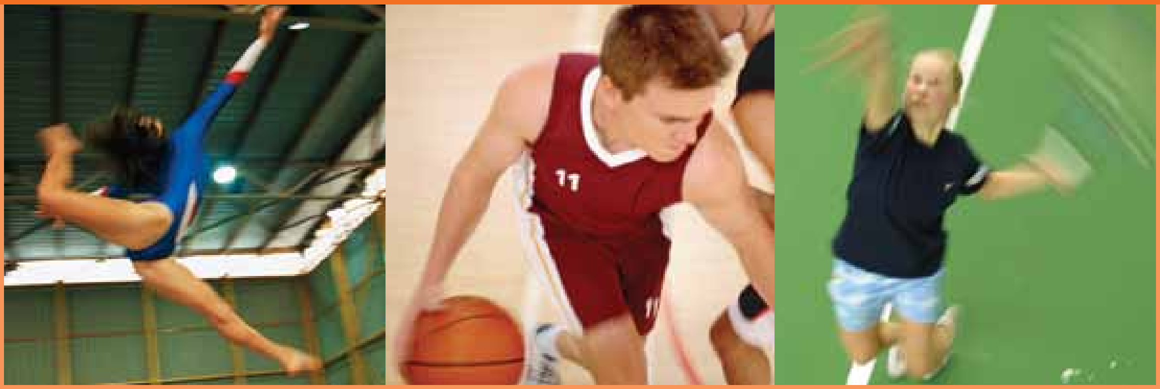
Sports Medicine Program



ACL Injury Prevention Manual

Children's
Healthcare of Atlanta

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Introduction

The Children's Healthcare of Atlanta Sports Medicine Program is dedicated to the treatment, rehabilitation and prevention of sports-related injuries. Our staff consists of sports medicine physicians, surgeons, physical therapists and athletic trainers—all specializing in the care of young athletes.

Recent trends have identified an increase in knee injuries involving the anterior cruciate ligament (ACL) in young athletes—especially females. With increased participation of young women in sports, at all levels, focus is shifting from surgical intervention and treatment to injury prevention. Several studies have indicated faulty mechanics and neuromuscular weakness as mechanisms for injury in the female athlete.

Our ACL Sports Performance Enhancement and Injury Prevention Program is geared toward both female and male athletes. This program is designed to improve speed, strength and agility, while incorporating proper mechanics and muscle recruitment for sports-related activities. Ultimately, through proper training, conditioning and the instruction of healthy guidelines, the risk of ACL injury will be reduced—all while improving sports performance.

Exercises in this manual take 10 to 15 minutes to complete. They can be done on the field or in a gym setting with minimal equipment.

The DVD located in the back of this manual contains exercises with step-by-step instructions to aid in ACL injury prevention.

Common Sports Injuries

Almost one-third of all injuries incurred in childhood and adolescence are sports related. Multiple studies and surveys performed during the past 10 years indicate that football, basketball and soccer players sustain the greatest number of sport-related injuries.

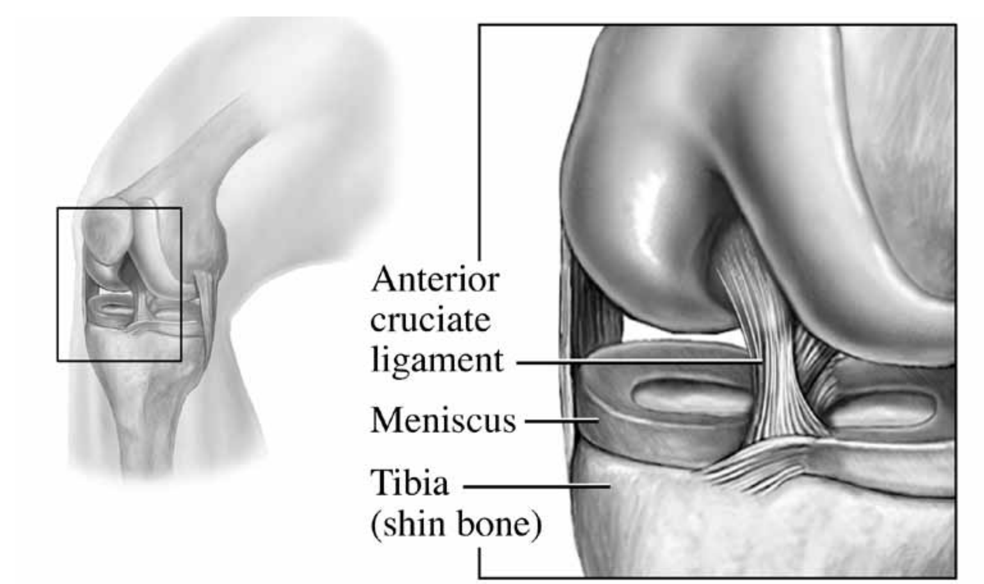
Statistically, males will experience more injuries than females. Strains and sprains account for the majority of these injuries. However, ACL injuries occur five to six times more often in females. In fact, one out of every 100 high school females will experience an ACL injury each year.

The anatomy of an ACL injury is not complicated. The ACL is located in the middle of the knee, and functions to stabilize the joint. An ACL injury is either a partial or complete tear resulting from direct knee trauma or an injury without contact. Two-thirds of all ACL injuries occur without contact, meaning the ligament typically fails with a sudden deceleration, an outside cut or any maneuver that causes shear force across the knee joint.

Anatomy and training differences are two main categories that combine to explain why there are more ACL injuries in females than males. Females have a different skeletal anatomy than males. Females tend to have a wider pelvis, bones that are not perfectly aligned and/or a narrower attachment point of the ACL. Strength, technique and coaching also account for differences.

In an attempt to reduce the number of ACL injuries, a lot of time and effort is spent researching training differences between males and females. The differences include: leg dominance, muscle recruitment order, the speed of muscle activation, strength, jumping and cutting techniques, and postural control. Each of these factors can be addressed and improved through an organized training program, thus decreasing (but not eliminating) the risk of a serious knee injury.

Injuries disrupt training and competitive sports participation, interfering with an athlete's ability to enhance his skills. The Sports Performance Enhancement and Injury Prevention Program is designed to help prevent these injuries, which will allow athletes to perform at their highest potential.



Injury Management

It is important to know how to manage sprains and strains to help minimize the ill effects and speed the healing process, reducing the amount of time lost from competition. The acronym **PRICEMM** is used to represent the most effective way to manage basic injuries. Continue PRICEMM for 72 hours. Seek medical attention if symptoms remain the same or worsen.

Protection:
Protect the injured area from any additional stress and strain, which may interfere with the healing process. Protection is based on the type of injury and the involved body part, and can be in the form of padding, a brace, sling or crutches to avoid weight bearing.

Rest:
Once a body part is injured, it immediately begins to heal. If the injured part is not rested and is subjected to additional external stresses and strains, the healing process never takes place or is slowed significantly.

Ice:
The initial treatment of acute injuries should be with cold. Cold is used to decrease pain and to control any internal bleeding and swelling. The cold should be applied for 15 to 20 minutes (note: excessive exposure to cold can damage tissues, and cold should not be applied to open wounds).

Compression:
In most cases, immediate compression of an injury is an important adjunct to cold and elevation. Placing external pressure on an injury assists in decreasing swelling by reducing the space available for the swelling to accumulate.

Elevation:
Elevation reduces internal bleeding. The injured body part, particularly a limb, should be elevated above the heart to eliminate the effects of gravity on the blood pooling. The injured body part should be elevated as much as possible during the first 72 hours.

Motion:
The athlete may begin mild range-of-motion exercises (not weight bearing) 24 hours after a sports injury occurs as long as it does not cause pain.

Medicine:
Nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly used for musculoskeletal injuries. Ask your doctor about using NSAIDS.

PRICEMM is an effective way to manage sprains and strains, but it is not a substitution for medical care.

Nutrition for Athletes

Nothing is more important to an athlete's well-being and ability to perform than proper nutrition. Eating the right foods helps athletes maintain desirable body weight, stay physically fit and establish optimum nerve-muscle reflexes.

Eating a variety of foods will help to ensure the body's nutritional needs are met. There are six major nutrient classes: carbohydrates, protein, fat, vitamins, minerals and water. Each of these nutrients performs a specific function in the body, and they all work together to provide good nutrition. A lack of just one nutrient places the body at a disadvantage.

Carbohydrates are the primary fuel source for high-intensity aerobic exercise. For endurance athletes, it is recommended that 55 percent to 65 percent of the diet come from carbohydrates to delay the onset of fatigue. Avoid consuming carbohydrates 15 to 45 minutes before a sport activity. Examples include fruits, rice, grains (pasta and breads) and some vegetables.

Protein is necessary for growth, repair and maintenance of the body's tissues. It also is used as an energy source, although this is not the body's preferred source of energy because it is difficult for the body to break down proteins to use as energy. It is recommended that protein comprise 15 percent of an athlete's diet. Examples include red meat, nuts, chicken, eggs, fish and tofu.

Fat should comprise less than 30 percent of the athlete's diet. Examples of fat include oils (fish, olive and canola), peanut butter and cheeses. Fat provides cushioning for vital organs to protect them from injury. Fat also helps maintain body heat.

Vitamins promote growth, maintain health and help the body to utilize the other forms of nutrients. Most vitamins are obtained through eating a healthy and varied diet. Examples include vitamins A, D (which is needed to maintain strong bones), B, C and E.

Minerals are inorganic substances and electrolytes. They account for about 4 percent of body weight. Examples include calcium (important for bones and muscle) and iron (to deliver oxygen to the muscles).

Water is essential for transportation of oxygen, nutrients, hormones and waste products. It helps regulate body temperature by dissipating body heat during exercise through the evaporation of sweat. Water also helps maintain blood pressure for proper cardiovascular function. Approximately 70 percent of body weight is comprised of water.

High energy levels are the result of good eating habits. One of the least-recognized nutrition problems of the teenage athlete is simply not consuming enough calories.

Participating in sports can drastically increase your food energy needs. Teenage athletes require a higher caloric intake from a variety of food sources. For example, an athletic teenage male may need 5,000 calories a day, compared to his nonathletic friends who require 3,000 calories.

The ideal diet for an athlete depends on many factors, including age, sex, body size, environmental training conditions, and duration, frequency and intensity of training. For most athletes, the increased energy should come from vegetable and grain sources (bread, rice and pasta). These foods contain a lot of starch, which is an excellent source of energy.

What an athlete eats before a competition can be critical. Before a game, the body's digestive processes may be slowed down by an athlete's elevated emotional state. Eating a meal three to four hours before a sporting event allows the meal to digest, thereby helping to avoid nausea or discomfort during exercise. The athlete should avoid foods that contain a lot of fat or oils because these are more slowly digested than other nutrients. Meals higher in carbohydrates are better because they are digested more rapidly. The athlete also should avoid sugary foods, such as candy and soda, before a competition, as these cause rapid swings in blood sugar levels and result in low blood sugar and decreased energy. Also avoid caffeine (coffee, tea and chocolate), as it may lead to dehydration.

All-day events, such as track meets or basketball and soccer tournaments, present the athlete with a nutritional challenge. Consuming several high carbohydrate minimeals with lots of fluids is an excellent approach. Each "meal" should be small (fewer than 300 calories) and low in sugar and fat. The athlete also should avoid eating within one hour of event time, if possible.

After the competition, the body's glycogen (starch), the main energy source in the muscle and liver tissues, has been used. In order to rebuild the body's glycogen stores, the athlete should consume nutritious foods and drinks high in carbohydrates. Ideally, the athlete should eat within 30 minutes after the competition to assist in rapid recovery.

Remember:

- Plan ahead—this means get up early to eat a good breakfast, eat a good-size lunch, drink water throughout the day and make time for a pregame dinner, as appropriate.
- With any pregame meal, choose foods that will digest easily (high in carbohydrates) and will not upset the stomach.
- Limit high-fiber, fried and high-fat food, which will take longer to digest.
- Restrict sugary foods and drinks that can cause rapid energy swings.
- Avoid foods and drinks that contain caffeine, which can contribute to dehydration.
- Snacks with foods that are high in nutrition can keep your energy levels consistent throughout the day.
- Allow at least one hour before game time for food to digest.
- Never try new foods before an event.
- Drink plenty of fluids.

Hydration

Your body is made up of 70 percent water—the equivalent of 10 to 12 gallons. It is important to keep the body fully hydrated, especially during training and competition. When an athlete sweats, water is lost from the blood, the fluid surrounding your cells and from within the cells themselves. For example, a football player can lose more than a gallon of sweat during an average practice or game, especially in hot weather. When this occurs, the athlete is in a state of dehydration that makes it difficult for the body to function properly.

Dehydration leads to early fatigue and overheating due to inadequate temperature regulation, which will significantly impair athletic performance and increase the risk of heat-related illness.

Percent of body weight lost as sweat	Physiological effect
2%	Impaired performance
4%	Capacity for muscular work declines
5%	Heat exhaustion occurs
7%	Hallucinations begin
10%	Circulatory collapse and heat stroke

Do not rely on your thirst. If you are thirsty, this means that you are already in a state of dehydration, and your athletic performance has diminished. Signs of dehydration include:

- Headache
- Dizziness
- Weakness
- Irritability
- Fatigue
- Muscle cramps
- Dark yellow strong-smelling urine
- Decreased frequency of urination
- Rapid resting heart rate

There is no one approach to hydration that will suit everyone. Fluid replacement should occur in three phases:

- **Before**: Consume at least 1 pint of water or a sports drink approximately two hours before the start of the activity.
- **During**: Drink fluids at regular intervals during exercise is essential to replace fluid lost through sweat. Drinking 6 ounces of cool water every 15 minutes is ideal. Hydrate, even if you are not thirsty. This will help your performance and prevent muscle cramping. Although water can meet fluid requirements, flavored sports drinks may be more effective at promoting drinking and maintaining an appropriate electrolyte balance.
- **After**: Replace every pound of body weight lost during exercise with at least 16 ounces of fluid, about 2 cups. When significant sweating occurs, consumption of salt, either from food or a beverage source, will minimize urine output and speed recovery of water and electrolyte balance.

Warm-up and Flexibility

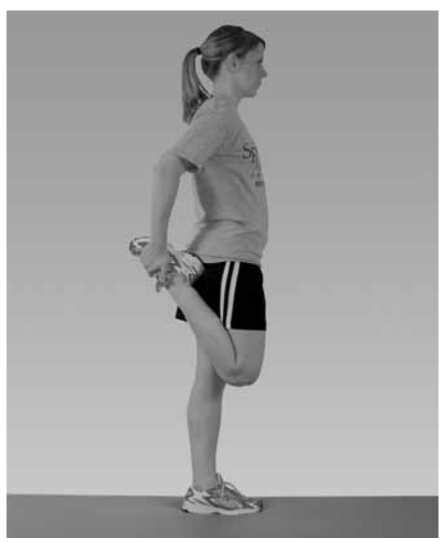
The general warm-up will be used to increase your body temperature and blood flow to your muscles to prepare them for exercise. It will consist of simple jogging and other exercises, such as side shuffling, skipping and carioca, which incorporate the large muscle groups in your legs.

The warm-up also includes dynamic stretching, which helps decrease the risk of injury. Dynamic stretching is more aggressive in increasing flexibility and is more sport-specific in nature. Some of the traditional movements associated with running, jumping and landing can be integrated into dynamic stretching, such as high knees, leg kicks and butt kicks.

Static stretching will be the final phase of the active warm-up. Selected major muscle groups will be held in a comfortable lengthened position for a short period of time. Static stretching should always be performed after the muscles are warm in order to make sure all the primary muscles used during the exercise session will be prepared for the demands of the training.

Static and dynamic stretching

For all stretches, hold 30 seconds and repeat three times on both sides.



Quad stretch

Hip flexor stretch

Butterfly stretch

Piriformis stretch

Hamstring stretch

Calf stretch

Mid-back stretch

Strength and Conditioning

Strength is the foundation for power, speed and agility and is essential for an athlete to control his body during a sport activity. Strength gains will help improve movement and enhance performance.

A functional and varied strength training program is more effective in improving performance. Functional training is a comprehensive approach that addresses all performance components—balance, reaction time, agility, acceleration and deceleration—necessary to achieve success in any sport. The emphasis of any type of physical training must be its transfer factor. Functional training explores this transfer factor—what you train for, you get.

Resistance training helps strengthen the muscles, tendons, ligaments and bones for improved force absorption. This aids in the avoidance of tissue failure or tearing with extreme loads during sport activity. Research has shown a significant reduction in injury rate and recovery time (26.2 percent and 2.02 days, respectively) among high school athletes who participated in a strength training program, as compared to athletes who did not strength train (72.4 percent injury rate and 4.82 days recovery time).

The cause of an injury must eventually be a part of its prevention. For example, if planting the foot and pivoting to change direction caused an ACL injury, then planting and pivoting must eventually be part of the conditioning program to prevent the injury from recurring.

The strength training program consists of functional exercises that utilize body weight, resistive bands, physio balls, medicine balls and hand weights to overload the muscles. Functional exercises require you to use your trunk, or core musculature, for balance. The goal of the functional exercises is to enhance total body conditioning by introducing controlled chaos. Training in unstable and chaotic environments will enable an athlete to perform better in unstable and chaotic game conditions.

Functional exercises used for performance enhancement

Planks (prone)

Planks (side)

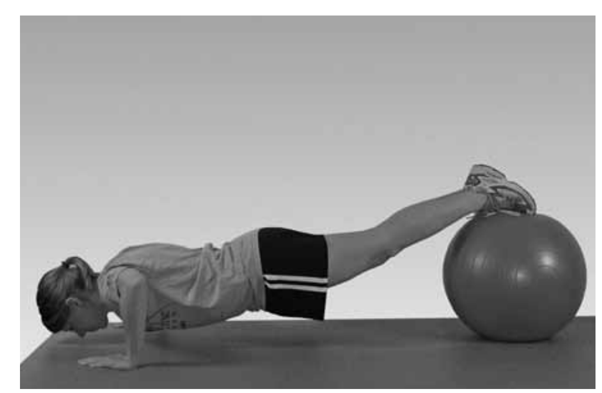
Squats (front view)

Squats (side view)

Torso pass

Forward lunge

Band walks (sideways)



Physio ball push-ups

Sports cord rows

Speed and Agility

Speed refers to the quickness of movement. When speed is integrated with maximum strength, power is the result. Power is important in any type of jumping or explosive changes in direction. Agility is the ability to change the direction of the body without losing speed, strength, balance or body control. The ability to change position without losing balance or speed is important in any sport where athletes are required to constantly change direction and speed of movement.

In many sports, acceleration power determines an athlete's ability to attain high speed of movement that is crucial when launching an offensive attack or chasing on defense. Deceleration power is just as important as acceleration power. In most sports, the need to decrease speed quickly is necessary to come to a quick stop in a short distance or to change direction quickly in a short distance.

Strong emphasis is placed on proper technique during planting, cutting, landing, starting and stopping drills. Not only will the speed and agility drills help to improve overall athletic performance, but they also will help guard against injury and delay the onset of fatigue, which will allow the athlete to perform safely during practice and games.

The speed and agility training will first teach the athlete proper form and execution of drills performed at submaximal speeds in controlled environments. It will then progress to training at game speeds in chaotic environments. Examples of proper progression through drills include:

– Slow to fast
– Simple to complex
– Stable to unstable
– Low force to high force
– General to specific
– Correct execution to increased intensity

This will allow the athlete to perform at an optimal level during competition.

Plyometrics

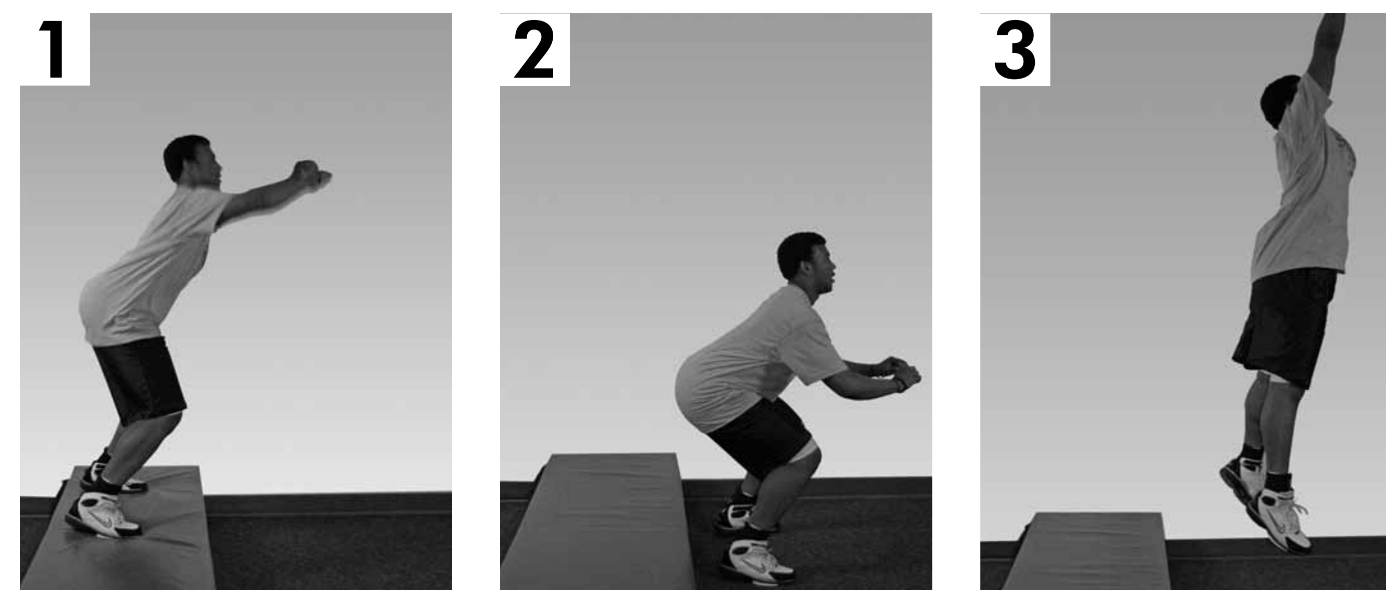
Plyometric exercises enable a muscle to reach its maximal force potential in the shortest amount of time. It does this by using what is referred to as a quick stretch reflex to produce maximal muscle contraction. This quick stretch reflex creates stored energy, which is released when followed by an immediate muscle contraction, increasing the total force production.

Because almost all sports require speed, power and explosive change of direction, it is essential to train in this manner. Plyometric training will enhance the athlete's ability to apply force in a rapid reaction. When executed with proper technique, plyometric training has consistently shown to improve the production of muscle force and power.

Female athletes are injured more than males due to noncontact mechanisms, such as landing or pivoting during running. A plyometric, strength and flexibility program has been shown to decrease high-landing forces and knee torques, which are related to knee injury. This training program will teach athletes neuromuscular control of the muscles surrounding the knee during landing, which will decrease the landing forces on the joint and help protect it from injury.

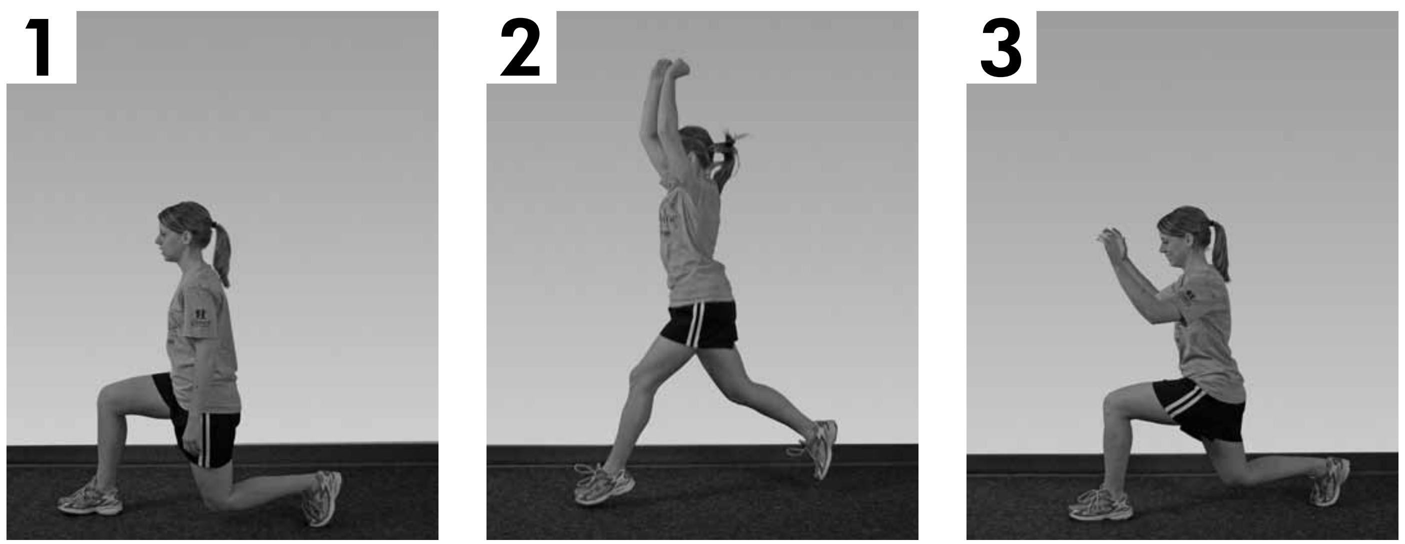
Examples of lower body plyometric exercises include skipping, hopping, bounding and jumping. Upper body and trunk plyometric exercises include modified pushups and medicine ball throws. These types of exercises will be implemented in the program.

Plyometrics



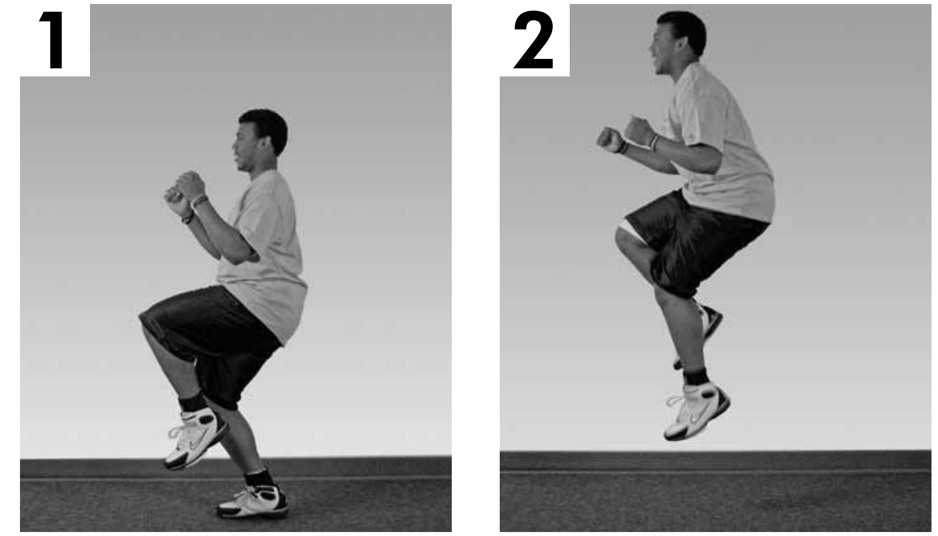
Depth jump (series)

Lateral cone hop (series)



Scissor jump (series)

Medicine ball toss



Bound in place (series)

Tuck jumps

Box jump (start)

Box jump (end)

Wall taps

Appendix

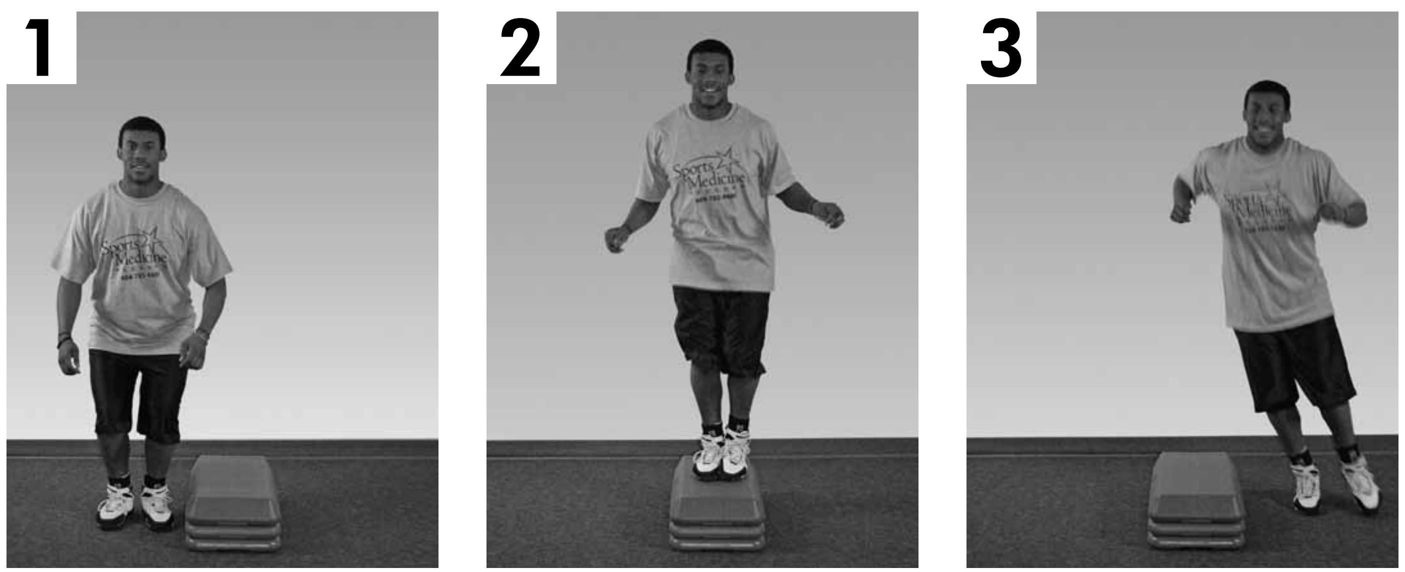
Glossary of Terms

Acceleration	An increase in speed of an action; rate of change in velocity for a given amount of time.
Agility	The ability to change direction without losing speed, strength, balance or body control.
ACL (anterior cruciate ligament)	One of the four major ligaments of the knee. It connects from a posteriolateral (back and outside) part of the femur (upper leg bone) to an anteriomedial (front and inside) part of the tibia (shin bone).
Balance	A biological system that enables you to know where your body is in the environment and to maintain a desired position.
Deceleration	A decrease in speed of an action; rate of change in velocity for a given amount of time.
Dehydration	Removal of water; a condition resulting from excessive loss of body fluid.
Electrolytes	Any of various ions, such as sodium, potassium or chloride, required by cells to regulate the electric charge and flow of water molecules across the cell membranes.
Fatigue	A feeling of tiredness due to continued activity; results in decreased ability to perform both physical and mental work.
Heat cramps	Painful muscle spasms in the abdomen, arms or legs following strenuous activity; often caused by a lack of salt in the body and usually affects people who sweat a lot during strenuous activity. The sweating depletes the body's salt and moisture. The low salt level in the muscles causes painful cramps.
Heat exhaustion	The body's response to an excessive loss of water and salt contained in sweat; occurs in people exercising in a hot environment. The person may be thirsty, giddy, weak, uncoordinated, nauseous or sweating profusely.
Heat stroke	Occurs when the body becomes unable to control its temperature; the body's temperature rises rapidly, the sweating mechanism fails and the body is unable to cool down. Body temperature may rise to 106°F (41.1°C) or higher within 10 to 15 minutes. Heat stroke can cause death or permanent disability if emergency treatment is not given.
Hydration	The act of becoming, or state of being, hydrated or having ample fluids in the body's system.
Inflammation	The body's tissue response to injury, irritation or infection in a localized area—this protective reaction may be characterized by pain, swelling, redness and sometimes loss of function.
Plyometrics	An exercise technique that combines strength with speed in order to achieve power with functional movements.
Power	The state of applying force; speed + strength = power.
Proprioception	The awareness of posture, movement and changes in space.
Speed	A rapid arm or leg movement; quickness.
Sprain	Stretch or tear of ligaments.
Strain	Stretch or tear of muscles, tendons or soft tissue.
Stretching	**Dynamic stretching** is the utilization of active movements to lengthen muscles. **Static stretching** is sustained, long-duration lengthening of muscles.
Strength	The ability of the muscles to generate force.

Appendix

Sample testing battery

Davies upper extremity closed-kinetic chain test (series)



60-second lateral box hop test (series)

90/90 hamstring flexibility

Plank test

Single-leg balance

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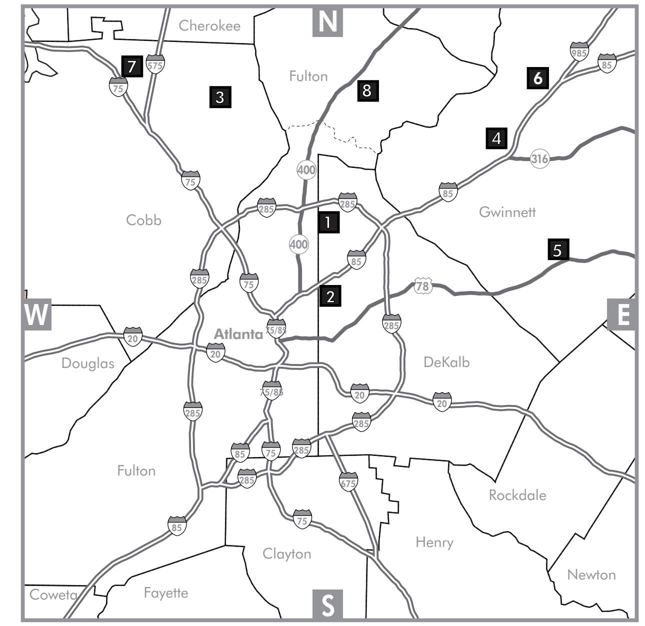
The Children's Sports Medicine Program Locations



1. Children's Healthcare at Meridian Mark Plaza
A Service of Children's at Scottish Rite
5445 Meridian Mark Road NE, Suite 290
Atlanta, GA 30342-4755
404-785-5699

2. Children's Healthcare at North Druid Hills
A Service of Children's at Egleston
1605 Chantilly Drive NE, Suite 200
Atlanta, GA 30324-3269
404-785-8421

3. Children's Healthcare at Sandy Plains
A Service of Children's at Egleston
3618 Sandy Plains Road, Suite 100
Marietta, GA 30066-3020
404-785-8316

4. Children's Healthcare at Satellite Boulevard
A Service of Children's at Scottish Rite
2660 Satellite Blvd.
Duluth, GA 30096-5803
404-785-8387

5. Children's Healthcare of Snellville
A Service of Children's at Scottish Rite
2220 Wisteria Drive
Snellville, GA 30078-2756
404-785-8081

6. Children's Healthcare of Suwanee
A Service of Children's at Scottish Rite
3640 Burnette Road
Suwanee, GA 30024-2191
404-785-8910

7. Children's Healthcare at Town Center
A Service of Children's at Scottish Rite
2985 George Busbee Parkway
Kennesaw, GA 30144-6812
404-785-8008

8. Children's Healthcare at Webb Bridge
A Service of Children's at Scottish Rite
3155 North Point Parkway
Building A, Suite 100
Alpharetta, GA 30005-5481
404-785-8570

Coming to The Avenue Forsyth in 2011

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