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# Plyometric Training Considerations to Reduce Knee Injuries

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Mike Nitka  
Column Editor

### summary

Strength and conditioning programs can serve a role in the prevention of injuries. Athletes who are at risk for a serious knee injury may benefit from a plyometric training program. The program that a high school coach develops or implements should be evidence based and address lower-extremity strength and biomechanical techniques.

**F**emale athletes participating in cutting or jumping sports are 4 to 6 times more likely to experience a serious knee injury than are their male counterparts (1). The mechanism of injury is usually noncontact and occurs when the athlete is making a sudden stop, making sharp cuts, or landing and pivoting. But why are women more susceptible to anterior cruciate ligament (ACL) tears?

## Plyometric Training Considerations to Reduce Knee Injuries

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Three theories explain why women sustain more injuries: hormonal, anatomical, and neuromuscular. First, female sex hormones increase ligamentous laxity, potentially affecting joint stability. Controversy exists on whether this joint laxity increases the incidence of injury. Second, anatomical considerations include

lower tensile strength of the ligament, a narrower femoral notch, and pelvic and lower-extremity malalignments. These anatomical and hormonal factors are unavoidable. However, the third and final theory regarding neuromuscular control can be addressed in a proper strength and conditioning program.

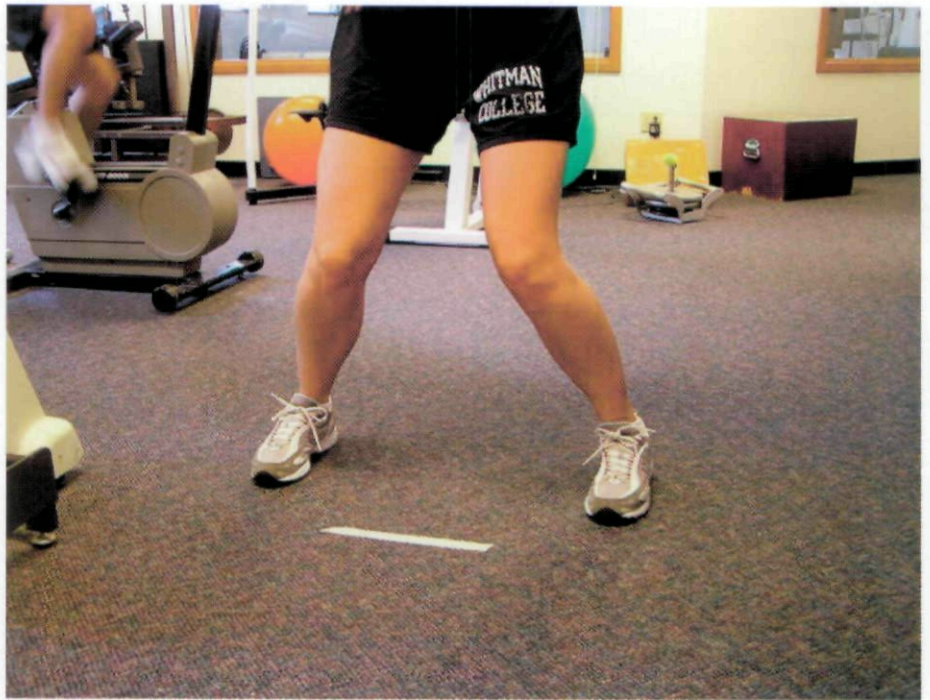


Figure 1. Landing with a valgus knee position.



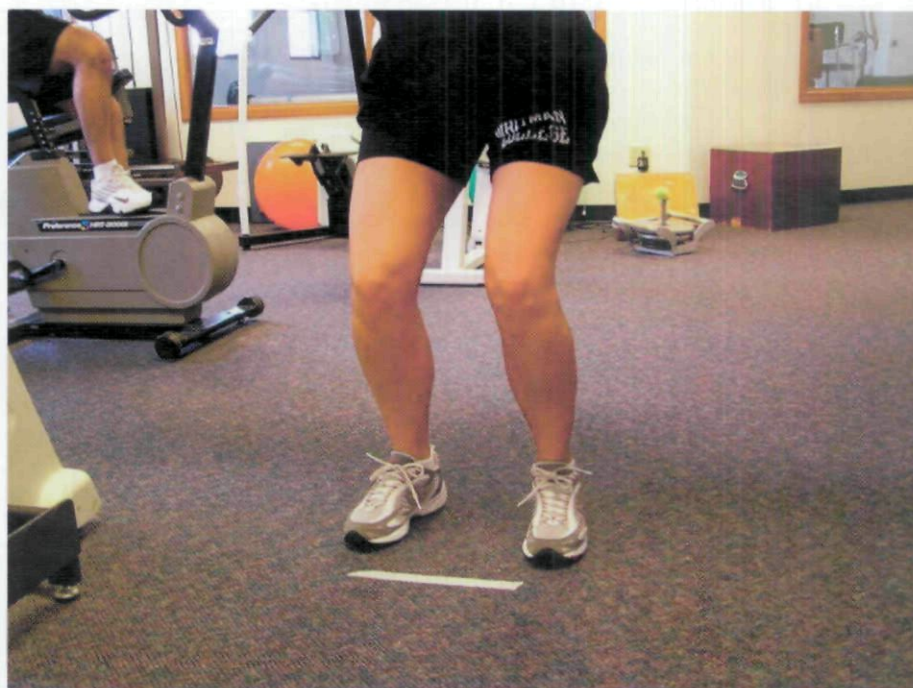
The neuromuscular control limitations of the female athlete can be categorized into delayed hamstring reaction and faulty knee mechanics during jumping and landing. Research has shown that female athletes rely upon their quadriceps during deceleration more than male athletes (2, 3). The reaction time and strength of the hamstrings, a dynamic supporter of the ACL, is proportionally slower and weaker in women. As anterior translation of the tibia on the femur occurs, the hamstrings provide less control, allowing more force to be applied to the ACL. Female athletes also tend to jump and land in excessive valgus or varus knee postures (Figure 1). This mechanism, when coupled with anterior tibial translation and rotation, can lead to knee injury.

Evidence shows that hamstring reaction and landing strategies can be improved through training programs. Supervised plyometric and strength training programs have demonstrated improved hamstring-quadriceps strength ratios, decreased landing forces, and decreased valgus and varus torques (2).

When developing a strength and conditioning program to improve the athlete's jumping ability and to minimize injury, the high school strength coach should progress the athlete through specific plyometric drills and the correction of faulty landing mechanics.

To begin any plyometric program, a warm-up should be performed, such as a 5- to 10-minute bike ride or light run. Next, the athlete should perform a dynamic lower-extremity stretching program to increase blood flow to the muscles and prepare them for activity.

The plyometric program (Table 1) should progress from low- to high-intensity jumps. Jumps in order of increasing intensity are jumping in place, standing jumps, bounding,



**Figure 2.** Proper landing mechanics.

**Table 1**  
**Sample Plyometric Program for First and Last Days of a 6- to 8-Week Program**

First day	Last day
Low-intensity jumps	High-intensity jumps
1:5 to 1:10 work-rest ratio	1:5 to 1:10 work-rest ratio
No more than 30 to 40 foot contacts this session	10 total sets, each 8 to 12 repetitions
Examples: Jump in place: 2-foot ankle hop Standing jump and reach Bounding in place	Examples: Standing long jump Front cone hops Box jumps: jump from box Lateral bounding Depth jump: 180° turn

multiple hops and jumps, box jumps, and depth jumps. Variations in each category exist. The strength coach should add variety to the training program to provide specificity of sport and to avoid stagnation and training boredom while maintaining the intensity order. Beginners should perform as few as 30 to 40 foot contacts during the initial sessions. As the athlete

demonstrates tolerance (no joint or muscle pain) and proper technique, the program can be advanced to medium- and high-intensity jumps with up to 100 or more foot contacts. Adequate recovery is important. A lower-extremity plyometric program should be performed only twice a week. During training, a work-rest ratio of 1:5 to 1:10 should be followed.



The purpose of such a program is to retrain the jumping and landing mechanics of the athlete. The strength coach's supervision of the athlete's lower-extremity alignment during jumping and landing is crucial for program success. Correction of landing errors is as important to preventing knee injury as implementation of plyometric training. Common landing errors include landing with a straight or hyperextended knee, landing with a varus or valgus knee position, and landing solely on the heels. Athletes who land from a jump with straight or hyperextended knees should be taught bent knee landings. Verbal and manual cues will help the athlete avoid varus or valgus knee landing positions. Athletes landing on their heels must be trained to land on their forefoot (Figure 2). They should be able to land and hold an aligned position for up to 5 seconds, which demonstrates neuromuscular control.

By implementing a coordination-based program, the 2 major components of faulty neuromuscular control can be corrected. As the athletes progress, they will become more familiar with proper landing mechanics and develop a more reactive and functionally supportive hamstrings complex. Although no program can guarantee the prevention of ACL tears, the risk can be greatly reduced. ♦

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