

U.S. Soccer Federation

ACL Injury Prevention Best Practices



Recognize

Anterior cruciate ligament (ACL) injuries are one of the most common knee injuries in sports, specifically in soccer athletes. As many as 250,000 ACL injuries occur each year in the United States^{1,2} with a majority results from non-contact injuries when attempting to land from a jump, decelerating while running, or changing direction³. These injuries result in significant time loss for athletes, averaging 6-12 months away from sport, with the recommended return to play being at least 9 months after surgery⁴. Furthermore, only 55% of athletes return to competitive sports after ACL injury⁵. Given the significance of ACL injuries, it is important to understand various factors that may increase an athlete's risk of ACL injury and to highlight programs that have proven to decrease injury risk.

There are numerous risk factors that increase a soccer player's risk of ACL injury. Some of these risk factors are non-modifiable and others are modifiable. Non-modifiable risk factors can include sex, age, anatomy and history of injury.

Non-Modifiable Risk Factors

- Age
- Sex
- Anatomy
- History of Injury

Modifiable Risk Factors

- Movement Patterns
- Fatigue
- Environment
- Psychological Readiness

Non-Modifiable

Sex

ACL injury rates among female athletes are consistently higher across playing levels compared to male athletes^{6,7}. The difference between sexes has been hypothesized to be influenced by anatomical differences and hormonal fluctuations across the menstrual cycle; however, the research on this is inconsistent^{8,9}. Changes in the development of strength, power, and body control during and after puberty may be another reason for the differences seen between sexes¹⁰. Despite this non-modifiable risk factor of sex, regular use of an exercise-based injury prevention program can reduce risk of ACL injury in female athletes by up to 45%.

Age

ACL injuries can occur more frequently in some age groups than others. ACL injury rates tend to increase in the early teens for females and the late teens for males^{17,18}. The female injury rate in collegiate soccer also exceeds the male rate three-fold⁶.



Injury History

Injury history can also influence ACL injury risk. Up to 30% of athletes who incur an ACL injury will experience another one¹⁹. The risk of an ACL injury can also increase while recovering from other injuries. So, it is important to ensure rehabilitation following an injury is comprehensive and that every deficit is thoroughly addressed prior to receiving clearance to return to training^{20,21}. Extending the rehabilitation timeline and delaying return to play for at least 9 months following surgery decreases the risk of re-injury by half for each month a player waits (up until 9 months)⁴. Monitoring psychological state and confidence during this rehabilitation period may also be important as both low and high psychological readiness have been associated with ACL reinjuries following return to sport.



Modifiable Risk Factors

Biomechanics

A potentially modifiable risk factor is biomechanics (i.e. movement patterns). Risky movement patterns for ACL injuries include letting the knee and leg collapse inwards, hyper-extending the leg, or having less knee bend when cutting, changing direction, decelerating, and landing from a jump or header²⁰. Regular participation in an exercise-based injury prevention program may help improve these movement patterns and assist in mitigating overall ACL injury risk.

Fatigue

Simulations of soccer-related movements following a fatigue protocol suggest there may be a deterioration in players' overall biomechanics²², but others have proposed that fatigued athletes do not generate sufficient forces for an ACL injury to occur²³. Studies of live soccer matches have demonstrated an even distribution of ACL injuries across the halves of matches suggesting that fatigue may not be a leading cause of injury²⁴. However, fatigue related to sudden increases in training load without appropriate adaption may increase overall injury risk for soccer players²⁵.

Environment

Environmental risk factors including playing surface and cleat/shoe choice are additional modifiable risk factors that have been explored. However, research studies have not shown a clear conclusion that new generation artificial turf poses



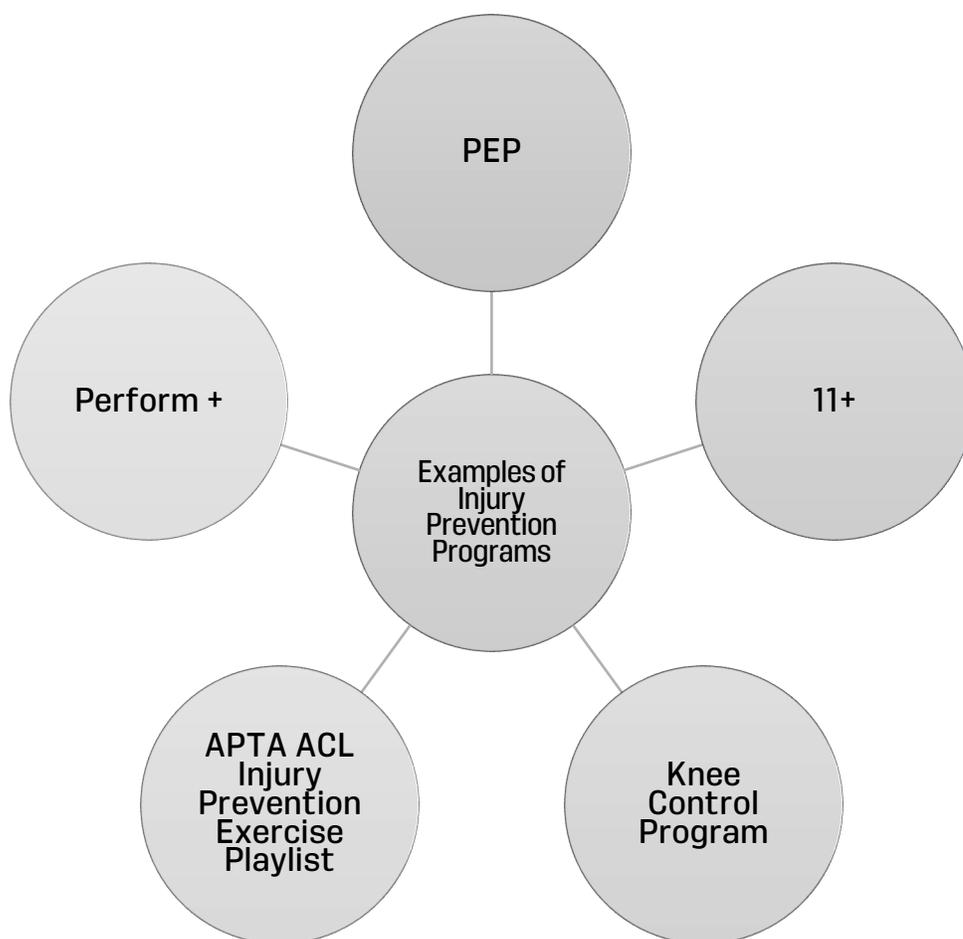
a higher risk than natural grass in soccer athletes, but may differ across age groups and sex²⁶⁻³⁰.

Psychological Readiness

Emotional and psychological support is a less studied but likely important modifier for ACL injuries. Creating an environment for athletes that is supportive of participation in injury prevention components, like strength training, may have potential to indirectly reduce non-contact ACL injuries³¹.

Recover

Although ACL injuries carry short- and long-term consequences, exercise-based injury prevention programs can significantly reduce the risk of injury. Participation in an exercise-based injury prevention program like the 11+ has also been shown to reduce the incidence and severity of overall injury rates-not just ACL injuries^{12,13}. Adherence to an exercise-based injury prevention program can lead to improvements in athletic markers may also improve team performance¹⁴⁻¹⁶ There are several key features to effective injury programs.





Most injury prevention programs are designed to be a pre-training warm-up in order to be time and socioeconomically friendly. Although it is ideal to complete the entire program prior to training, some components of the injury prevention programs may be able to be completed separately from training. For example, Part II (the strengthening portion) of the 11+ can be completed after training and retain the injury reduction benefits of the program on days where completing the whole program before training isn't possible³². Additionally, the Perform+ program is designed to have a warm-up component and a post-training strengthening component.

Even though many injury prevention programs are designed to be a warm-up, **they should be used in the off-season too, in order to avoid biomechanical decline or return of old movement patterns that are not ideal.** Initiating use of an injury prevention program during pre-season may enhance its effectiveness³³. In terms of weekly completion, **regular adherence to the program is important.** Injury prevention programs are most effective when completed **at least twice a week.** Ideally, these programs are 20 minutes or more in duration³³.

The injury prevention programs with the strongest evidence are structured, multi-component programs¹¹.



Perform +

- Multicomponent
- Flexibility in completing the different components of the program
- Warm Up Component
- Post Training Strengthening Component



11+

- Multicomponent
- Pre-training Warm Up
- Part II - the strengthening component can be completed post training



PEP

- Multicomponent
- Warm Up Exercises
- Strength training exercises
- Plyometrics
- Agility Exercises
- Flexibility Exercises



Knee Control Program

- Multicomponent
- Various Levels of Difficulty
- Strength training exercises



American Physical Therapy ACL Injury Prevention Playlist

- Multicomponent
- Basic warm up exercises geared towards injury prevention

Program Links:

[PEP Program](#)

[FIFA 11+ Playlist](#)

[Perform +](#)

[Knee Control Program](#)

[APTA Clinical Practice Guidelines on ACL Injury Prevention Exercise Playlist](#)



The most effective components include: lower-extremity strengthening, core strengthening, and plyometrics. Balance and agility exercises are other common components. Feedback on technique while completing exercises may be optimized when it is less focused on bodily actions (e.g. “Bend your knees”) and more focused on the result of the action (e.g. “Land softly”)³⁴.

Fortunately, leading medical professionals and researchers have created several open-access injury prevention programs. These programs, shown in the table above, require minimal equipment and are designed to be implemented by coaches and assistant staff, or even players. Below is a list of common exercises included in many of the common well known injury prevention programs.





Table 1.

Injury Prevention Program Common Exercises
<u>General Warm Up Exercises</u>
Running Straight Ahead
Hip Circles (In and Out)
Running in Circle Around Partner or Cone
Running with Shoulder Contact
Quick Forward and Backwards Running
Building speed runs
Bounding
Plant and Cut Running
Other Dynamic Warm Up Exercises
<u>Strengthening Exercises</u>
Plank and Variations
Side Plank and Variations
Groin/Adductor Strengthening Exercises (Copenhagen Variations)
Hamstring Strengthening (Partner Nordic Hamstring Variations)
Hip Bridge (Double Leg and Single Leg Variations)
Lunge Variations
Lateral Lunge Variations
Double Leg Squat Variations
Single Leg Squat Variations
Calf Raises (Single Leg and Double Leg)
<u>Balance Exercises</u>
Single Leg Balance - increasing challenge variations - eyes open/closed, ball tossing, partner challenge
<u>Plyometric Exercises</u>
Vertical Jump
Lateral Jump
Multi-direction Jumps (Double Leg and Single Leg Variations)
Hops (Double Leg and Single Leg)
Single Leg Jumps
Jumping Lunges
Change of Direction Single Leg Jumps
<u>Cool down and Flexibility Exercises</u>
General Lower Extremity Flexibility Exercises
Quadriцеп, Hip Flexor, Hip/Glute, Adductor/Groin, Hamstring, Calf Stretches



Check Your Knowledge

- True or false: ACL injury rates can be reduced.
- True or false: Injury prevention programs are expensive.
 - Multiple choice:

What are the strongest components of prevention programs?

- A) Plyometrics
- B) Stretching
- C) Taping
- D) Hip & core strengthening.
- E) A & D

(Answers: T, F, E)



Contributors

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