

Non-Contact ACL Injury Prevention for Females

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Introduction

Since the inception of Title IX there has been a tremendous growth in the number of young women who participate in sport and physical activity. In the past 15 years the number of women participating in college soccer, volleyball and basketball has increased 210%, 39%, 40%, respectively (14). This increase in sport participation has also been associated with an increased number of injuries in female athletes; specifically non-contact ACL tears. Soccer, volleyball, and basketball have been identified as high risk sports for non-contact ACL injuries in female athletes. It has been reported that women are 2-8 times more likely to sustain an ACL injury compared to their male counterparts who participate in the same sports (1, 5, 7).

It is estimated that 38,000 ACL injuries occur each year in female athletes (16), with an associated cost of \$17,000 for repair and rehabilitation per patient (8). Aside from the financial costs, rehabilitation from this type of injury takes at least 4-6 months, resulting in a significant loss of playing time. Thus, the focus of researchers over the past decade has been to develop prevention strategies aimed at reducing the incidence of this injury.

Several mechanisms have been identified that are associated with an increased risk of non-contact ACL injuries in female athletes and are divided into external and internal factors. External factors include shoe-surface interactions, surface type, and the weather. Internal factors include anatomical, neuromuscular, biomechanical, and hormonal factors. Since sport performance professionals are unable to alter an athlete's anatomy, should not tamper with a woman's hormonal environment, and do not have much control over the weather, the approach that will have the greatest impact on injury risk reduction is to alter and improve the biomechanical and neuromuscular characteristics that predispose young women to non-contact ACL injuries (2, 7, 12).

Importance / Current Trends

Before puberty boys and girls have similar movement characteristics. They run, sprint, jump, and land with similar biomechanics. After puberty, however, noticeable gender differences are observed for these motor skills (13). Specifically, women tend to: 1) land from a jump with straighter legs (i.e., no bend in the knees/hips), which is often termed a 'stiff' landing (6); 2) have greater knee valgus, where the knees buckle inwards, when landing from a jump; 3) stop or change directions using one large step (3, 11); and 4) activate the quadriceps prior to the hamstrings during changes in direction and when landing from a jump (10). These four aspects have been identified as key mechanisms in the etiology for non-contact ACL injuries in female athletes. Fortunately, using specific instructions with sprint, agility, and plyometric drills can help young women alter faulty movement characteristics and possibly improve neuromuscular risk factors, thereby reducing the risk of injury.

What the research has indicated

Several injury prevention programs exist that are aimed at placing female athletes into safer biomechanical postures (4). Altering specific aspects of jumping, landing, and changing direction have been the primary targets of these injury intervention programs. The most common techniques are to: 1) change 'stiff' landings into 'soft' landings by having athletes bend their hips and knees upon landing from a jump; 2) make athletes consciously aware of maintaining proper knee alignment upon landing from double leg and single leg landings; and 3) replace the one-step stop or change in direction with multiple, small steps. These simple modifications will improve biomechanical aspects of many common movements found in soccer, volleyball, and basketball. In addition, by modifying biomechanical aspects of landing from jumps, beneficial alterations in neuromuscular firing patterns occur that allow the hamstrings to assist in stabilizing the knee joint, thus reducing the strain placed on the ACL.

Implementing a prevention program has been shown to decrease peak landing forces by 22 % (9) and reduce ACL injuries by 88% (15) in younger athletes, however to date it is questionable whether these programs provide any protective benefit to older, college-aged athletes. It is unclear why this phenomenon has occurred; however, modifying several limitations of the most common programs may help to rectify the differences observed between younger and older female athletes.

First, reports from the scientific literature describe exercise programs that tend to be static. In other words, there is no developmental progression and the same drills are simply repeated for as long as the program is incorporated into a training routine. It simply does not make sense that a 12 year old and 23 year old soccer player would perform the same drills with the same movement cues. It is unnecessary to alter exercises on a daily, weekly, or even monthly basis, but changes should occur as an athlete matures and skill acquisition is mastered.

Second, the duration of research studies examining the impact of ACL injury prevention programs is extremely short, lasting only 6-8 weeks. Injury prevention strategies for non-contact ACL tears should not be treated any differently than other sport-specific motor skills. A young basketball player would not be taught how to shoot free throws for one month and then be expected to be successful many months, or years, later without having continuously practiced. Appropriate drills and, more importantly, specific biomechanical cues (e.g., bend the knees and hips upon landing, use multiple step stops) should be included as part of a comprehensive injury prevention strategy.

Finally, the intensity and complexity of exercises found in ACL injury prevention programs are often non-specific. Most of the programs require female athletes to perform jumping drills on mats with the focus on soft landings, or complete sprint and agility drills at slow speeds. Unfortunately, the demands of participating in sport require athletes perform high speed sprints, unplanned changes in direction, or land from a jump with another player in close proximity. Therefore, exercises should be carefully selected, but become increasingly more complex and demanding (without increasing the risk of injury) as an athlete is able to master simple movement skills.

Practical Applications

Sports performance professionals and coaches should routinely include appropriate movement specific drills, using proper cues, as part of a comprehensive injury prevention strategy. These motor skills are just as important as learning how to kick a soccer ball, spike a volleyball, or shoot a foul shot. Implementing exercises with appropriate cues at a young age, even though young girls move similarly to boys prior to puberty, is important for establishing a strong foundation of proper motor skills. This will help to ensure that advanced drills can be used as they mature and the demands of the game/sport increase. Younger or lower level athletes should perform less complex drills and perform them at slow speeds. More advanced or older athletes can perform similar drills but at faster speeds and with greater complexity.

The vertical jump is an example where the focus will always be on proper landing technique. A progression using this exercise could start by having the athlete place their hands on their hips and perform a submaximal vertical jump (Step 1). Next, the arms could be placed in various positions, such as above the head or in front of the body while performing a vertical jump (Step 2). Another variation could have the athlete perform some type of sport-specific movement (e.g., heading a soccer ball, catching a basketball) while completing a vertical jump (Step 3). Finally in the progression, a partner could stand in close proximity during the execution of the drill (Step 4). Each of these alterations in body position or to the environment can have an impact on movement and will increase the difficulty of performing a simple task like a vertical jump.

Conclusion

The incidence of non-contact ACL injuries is greater in young women compared to young men. Although various internal and external factors may predispose a female athlete to this injury, prevention strategies that focus on biomechanical and neuromuscular factors are beneficial for reducing injury risk in young female athletes. Routinely including sprint, agility, and jumping drills with specific movement cues will help to improve faulty movement mechanics and reduce the risk of non-contact ACL injuries in female athletes.

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