

Orthopedic Study: ACL Prevention Programs

A comparison of gender differences (and prevention techniques) for ACL injuries.

The latest edition of Orthopedics Journal (yup, the Clips MotherShip receives every issue) tackles the question of whether ACL injuries can be avoided.

We have summarized a new study on ACL prevention techniques from Doctors Hewett and Johnson from, respectively, the University of Cincinnati College of Medicine and the University of Kentucky.

The doctors start off their report with a bold and unambiguous statement, "Neuromuscular training has a significant effect on reducing relative ACL injury risk in female athletes in high-risk landing and cutting sports like soccer, basketball, volleyball, and team handball."

From there (and we paraphrase and summarize):

- about 5% of college and 1-2% of high school female athletes sustain an ACL injury in any given year
- neuromuscular training has a significant effect, from 24% to 82% reduction of relative ACL injury risk in female athletes in high-risk landing and cutting sports like soccer, basketball, volleyball, and team handball.

There is a great gender inequity in ACL injury:

- The NCAA reported over 150,000 female participants in varsity sports each year.
- The NFSHSA reported over 3.2 million female participants annually in high school sports programs.
- Over 50,000 debilitating ACL injuries likely occur in female athletes at the high school and college varsity levels during an average year.

Are Female Athletes Really at Higher Risk for ACL Injuries?

Since the enactment of Title IX, male participation at the high school level has remained steady, while female participation has increased approximately ten-fold (from less than 300,000 to over 3.2 million).

At an estimated cost of \$17,000 per patient to reconstruct and rehabilitate the ACL, overall costs would exceed \$680 million annually.

A major theory to account for higher knee injury incidence in female athletes is that neuromuscular imbalances, due to training deficiencies, developmental differences, or perhaps hormonal influences, lead to higher injury rates. Other variables that may be contributory include lower limb alignment as well as biomechanics and kinematics, overall ligament size and strength, and muscular fatigue over a given length of time.

This article focuses on the neuromuscular theory for 2 reasons. First, if neuromuscular training can alter observed neuromuscular imbalances in the laboratory and if the same neuromuscular training can decrease ACL injury risk on the field and court, then neuromuscular control must be a primary underlying factor for increased risk.

Second, intervention and prevention are likely to have the greatest impact on neuromuscular control, where adaptation readily occurs, if properly guided by trained health care professionals.

Does Neuromuscular Training Decrease the Incidence of ACL Injury?

The majority of published studies demonstrate that neuromuscular training has an approximately 50% efficacy rate for decreasing relative ACL injury risk in female athletes in landing and cutting sports like soccer, basketball, volleyball, and team handball.

Hewett et al reported the first prospective study of the effects of a neuromuscular training program on ACL injury in the high-risk female sports population. The rate of ACL injury was decreased 45% in the trained group relative to the untrained group. Hewitt's findings and several other studies have provided strong evidence demonstrating that neuromuscular training is likely to prove an effective solution to the problem of sex bias in ACL injury risk.

Figure 1: Percent decrease in ACL injuries

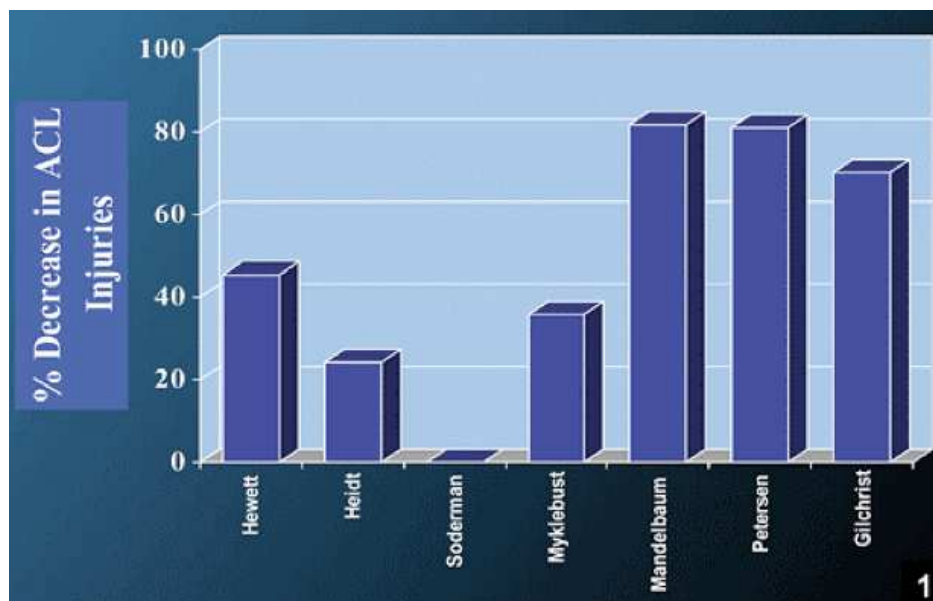


Figure 1: Percent decrease in ACL injuries in 7 ACL injury prevention neuromuscular training studies. The range of effect sizes of these studies was 24% to 82% reduction, and the average decrease in risk was approximately one-half (mean, 48%) reduction in ACL injury risk with neuromuscular training. (Hewett TE et al,² Heidt RS Jr et al,¹³ Mandelbaum B,¹⁴ Söderman K et al,¹⁵ Myklebust G et al,¹⁶ Petersen W et al,¹⁷ Gilchrist J et al.¹⁸)

How Does Neuromuscular Training Decrease Incidence of ACL Injury?

Four neuromuscular imbalances are observed more often in female than male athletes.

- The first observed neuromuscular imbalance is the tendency for females to be ligament dominant..
- Another imbalance is termed quadriceps dominance.
- A third imbalance is leg dominance. Leg dominance is the imbalance between muscular strength and coordination on opposite limbs, with 1 limb often demonstrating greater strength and coordination.

- The final imbalance often observed in female athletes is trunk dominance. Trunk dominance is characterized by increased motion of the body's center of mass due to the absence of neuromuscular control of approximately two-thirds of the body mass during single-leg landing, pivoting, or deceleration.

Figure 2 shows the gender disparity in knee abduction motion and load between female and male athletes when dropping off of a box and progressing into a maximum vertical jump.



Figure 2A: Decreased dynamic valgus motion

Figure 2B: Increased dynamic valgus motion

Figure 2C: Decreased dynamic valgus motion in a male athlete

Figure 2: Differences in valgus knee motion between female and male athletes when dropping off a box and progressing into a maximum vertical jump (performing a drop vertical jump maneuver). Decreased dynamic valgus motion during landing in a trained or preadolescent female (A). Increased dynamic valgus motion during landing in an untrained or mature adolescent female (B). Decreased dynamic valgus motion in a male athlete (C).

During landing, pivoting, or deceleration, the motion of the female athlete's trunk is often excessive and directed by that body segment's inertia, rather than by the athlete's core muscle contraction patterns. This results in excessive trunk motion, especially in the frontal or coronal plane, and high ground reaction forces and knee joint abduction torques.

It is important to note that several knee injury prevention training programs have been published and shown to be effective in improving neuromuscular deficits and reducing the risk of knee injuries, particularly in the female at-risk athlete. All successful programs incorporate the following key elements: a dynamic warm-up period; plyometric/jump training with emphasis placed on body posture and control, trunk positioning, dynamic core balance, and entire-body control; strength training for the core and lower extremity; sports-specific aerobic and skill components; and pre-season and in-season training programs.

The goal of this program is to avoid injury by teaching athletes strategies to avoid vulnerable positions, improve strength and flexibility, and improve proprioception. Those of us fortunate enough to be involved in youth, high school, and collegiate athletics should pass this information on to our sports medicine team colleagues whenever possible.

Find all the details by clicking on the link below

*This summary was distilled by Clips Editor Nick Infante from a 2,486 word study entitled “ACL Prevention Programs: Fact or Fiction?” by Timothy E. Hewett, PhD and Darren L. Johnson, MD, from the Jan. 2010 edition of Orthopedics Supersite. To access the study in its entirety [**click here**](#)*