

Reducing ACL Injuries in Female Athletes

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Clinical Question

What strategies are effective for reducing anterior cruciate ligament (ACL) injuries in female athletes?

Evidence-Based Answer

Neuromuscular training programs that include plyometric and strengthening exercises significantly reduce noncontact ACL injuries in female soccer and handball players older than 14 years. (Strength of Recommendation: A, based on a meta-analysis). Contact ACL injuries in soccer and handball players were not included in the meta-analysis. There were not enough participants in other sports to determine whether neuromuscular training programs would reduce noncontact ACL injuries in those athletes.

Evidence Summary

A meta-analysis of seven studies (three prospective randomized controlled trials and four prospective nonrandomized controlled trials) found that neuromuscular training programs significantly reduced noncontact ACL injuries in female athletes who played soccer or handball.¹ Athletes were 14 years or older, with 79 percent between 14 and 18 years of age. A total of 3,999 athletes were assigned to neuromuscular training and 6,462 athletes were assigned to control groups. Most of the athletes played soccer (n = 8,492) or handball (n = 2,126), with some also playing basketball or volleyball (n = 157). Neuromuscular training consisted primarily of plyometric exercises (i.e., explosive movements to improve performance), usually combined with strengthening exercises and sometimes balancing exercises. Training sessions ranged from 10 to 75 minutes per day. Two trials (n = 1,129) were

conducted during preseason training, three trials (n = 7,363) during in-season training, and two trials (n = 2,126) during both.

Investigators pooled data using an intention-to-treat analysis and found a reduction in the incidence of ACL injuries in trained athletes compared with untrained athletes (0.85 versus 1.9 percent; odds ratio [OR] = 0.40; 95% confidence interval [CI], 0.27 to 0.60). However, there were differences based on age. Neuromuscular training reduced the incidence of ACL injuries in athletes 18 years and younger (OR = 0.27; 95% CI, 0.14 to 0.49), but not in athletes older than 18 years (OR = 0.78; 95% CI, 0.23 to 2.64). Training also led to a greater reduction in ACL injuries in soccer players (OR = 0.32; 95% CI, 0.19 to 0.56) compared with handball players (OR = 0.54; 95% CI, 0.30 to 0.97).

The timing of neuromuscular training also affected the incidence of ACL injuries. Training programs that began in the preseason and continued into the season reduced the incidence of ACL injuries (OR = 0.54; 95% CI, 0.30 to 0.97), as did in-season training programs (OR = 0.32; 95% CI, 0.17 to 0.59). Preseason training alone did not reduce ACL injuries (OR = 0.35; 95% CI, 0.10 to 1.21).

Of the three components of neuromuscular training, plyometric exercises (OR = 0.37; 95% CI, 0.24 to 0.55) and strengthening exercises (OR = 0.21; 95% CI, 0.11 to 0.43) reduced the incidence of ACL injuries, but not balancing exercises (OR = 0.63; 95% CI, 0.37 to 1.09).

The investigators excluded one study with 10- to 15-minute training sessions, and found a slightly greater reduction in noncontact ACL injuries in the remaining six studies. ►

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Supported by an educational grant from
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These included four studies with longer, higher-intensity sessions (20 to 75 minutes each day) and two with shorter, 10- to 15-minute sessions (OR = 0.37; 95% CI, 0.24 to 0.55).¹

A subsequent randomized controlled trial found that neuromuscular training reduced noncontact ACL injuries in young female soccer players, but the difference did not achieve statistical significance.² Athletes were randomized to an intervention group (n = 583) performing 46 minutes of stretching, plyometrics, strengthening, and agility exercises; or to a control group (n = 852) performing 12 minutes of exercises (time spent exercising was confirmed by observation). There was a trend toward fewer ACL injuries in the training group than in the control group (5.7 versus 18.9 injuries per 1,000 athlete exposures; *P* = .066).

Recommendations from Others

The consensus statement of the 2005 Hunt Valley II meeting on noncontact ACL injuries found good evidence that neuromuscular training that includes plyometric, balance, and technique training reduces the risk of serious knee injuries in female athletes.³

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Author disclosure: Nothing to disclose.

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