

Neuromuscular Retraining in High School Female Athletes: Effects on Athletic Performance Indices and Anterior Cruciate Ligament Injury Rates

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Summary:

A 6-week supervised neuromuscular training program significantly decreased the risk of noncontact ACL injuries in 700 female high school athletes compared with matched controls, and significantly improved neuromuscular and athletic performance indicators such as overall lower leg alignment on landing, single-leg hop distance, and maximal oxygen uptake in a multi-stage fitness test.

Abstract:

INTRODUCTION

While many ACL prevention programs have been published, few have demonstrated significant reductions in injury rates and improvements in athletic performance indicators. These goals must be accomplished before widespread recommendations can be made for athletes participating in high-risk sports to undergo such training.

METHODS

We developed a program of supervised neuromuscular retraining* to alter body movement and positioning during jumping/landing and cutting/pivoting. The program entails 18 sessions (1-1.5 hrs each) and includes sports-specific drills and conditioning. A battery of tests is conducted before the first training session and within 1 week of the last session. The tests include a video drop-jump test, single-leg hop tests, vertical jump tests, isokinetic muscle tests, speed and agility tests, multi-stage fitness test, and the 1-minute sit-up test. Our first goal is to describe the changes in neuromuscular and athletic performance indicators measured after training in 1,000 female athletes 13-18 years of age. The second goal is to describe the difference in noncontact ACL injury rates in a subset of 700 trained athletes compared with that of 700 athletes matched for age, sport, and body mass index. We hypothesized that our program would significantly decrease the risk of noncontact ACL injuries in female high school athletes, and significantly improve neuromuscular and athletic performance indicators.

RESULTS

There were statistically significant improvements and large effect sizes (ES) in overall lower leg alignment in the coronal plane on the drop-jump test ($P < .0001$, ES .97). Before training, 79% (719 of 912) had a valgus alignment appearance on landing. The program markedly improved the alignment in 541 (75%) of these athletes. There were significant improvements in the single-leg triple crossover hop ($P < .0001$, ES .47) in the distance hopped (mean, 32 cm). In addition, 24% had abnormal limb symmetry on this test before training, whereas only 2% were rated abnormal after completing the program. There were significant improvements in the agility T-test ($P < .0001$, ES .64) and the multi-stage fitness test ($P < .0001$, ES .57). Isokinetic hamstring strength significantly improved ($P < .0001$, ES .57 dominant, .61 nondominant), as well as quadriceps strength ($P < .01$, ES .27 dominant, .35 nondominant). Significant improvements, but low effect sizes, were found in the vertical jump and sit-up tests. The subgroup of 700 trained athletes had a significant reduction in the noncontact ACL injury incidence rate (according to athlete exposures [AE]) compared with the control group. The trained group had 36,724 AE and 1 ACL injury, while the

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control group had 61,244 AE and 13 ACL injuries (incidence rates, .03 and .21 per 1000 athlete-exposures, respectively, $P = .03$).

CONCLUSIONS

The neuromuscular training program resulted in a significant reduction in noncontact ACL injury incidence rates. Whether the improvements in neuromuscular indices and athletic performance indicators correlated with the reduction in injury rates is unknown. Still, the high percentage of athletes who demonstrated poor technique on landing from a jump before training is concerning and demonstrates the need for this type of training in high school female athletes.