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# ACL-SPORTS Randomized Control Trial 1- and 2-Year Clinical and Functional Outcomes in Women: 100% Return-to-Sport Rates and High Outcome Scores, but No Between Group Differences

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**Summary**:
The addition of perturbation training did not provide further benefit, but the strength, agility, plyometric, and prevention training among female athletes in the ACL-SPORTS randomized control trial resulted in exceedingly high strength, function, and patient-reported outcome measures; 100% returned to sport, 87% at their pre-injury level, by 2 years after ACL reconstruction.

**Abstract**:

## Introduction

Outcomes after anterior cruciate ligament (ACL) injury and ACL reconstruction (ACLR) are not uniformly good and are worse among young female athletes. Developing and evaluating rigorous rehabilitation and return-to-sports training programs are essential for improving outcomes. We developed the Anterior Cruciate Ligament Specialized Return-to-Sports (ACL-SPORTS) randomized control trial to test the effect of strength, agility, plyometric, and secondary prevention (SAPP) exercises with and without perturbation (neuromuscular) training (SAPP+PERT). The purpose was to compare SAPP versus SAPP+PERT training on return-to-sport rates and strength, functional performance, and patient-reported outcomes in female athletes 1 and 2 years after ACLR.

## Methods

This study was a prospective randomized control trial (NCT01773317); IRB approval and informed consent were obtained. According to our a priori power analysis calculations, we needed 36 participants. We enrolled 39 female athletes between 3 and 9 months after primary ACLR when they had achieved at least 80% quadriceps strength, minimal to no effusion, full knee range of motion, and initiation of a running progression. Athletes were excluded if they had a previous ACL injury or lower extremity surgery, had a concomitant grade III knee ligament injury or large (>1cm^2) osteochondral defect, were not age 13-55 years, or did not participate regularly (50 hrs/yr) in jumping, cutting or pivoting sports. Participants were randomized to receive SAPP or SAPP+PERT training; they subsequently completed 10 training sessions (~2x/week). Athletes were tested 1 and 2 years after primary ACLR on clinical and functional measures including: isometric quadriceps strength index (QI) using an isokinetic dynamometer with the knee flexed to 90°; limb symmetry index on 4 single-leg hop tests (single, triple, crossover, and timed 6-meter); Knee Outcome Survey–Activities of Daily Living Subscale; Global Rating Score; and the International Knee Documentation Committee 2000 subjective score. Between group comparisons at 1 and 2 years were made using independent t-

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tests (a=0.05). We also calculated the proportion of athletes in each group who had returned to sport (at any level and their self-reported pre-injury level) by 2 years, comparing groups using Fisher's Exact tests (a=0.05). Baseline characteristics were similar between groups.

## Results

All athletes (39/39, 100%) had returned to sport by 2 years, including 87% (34/39) at their self-reported pre-injury level (SAPP: 19/20 and SAPP+PERT: 15/19, p=0.182). There were no between group differences in return-to-sport rates. There were no significant or clinically meaningful differences between the SAPP and SAPP+PERT groups at either time-point for QI (1yr: SAPP: 99%, SAPP+PERT: 100%; 2yr: SAPP: 105%, SAPP +PERT: 102%), single-leg hop tests (1yr: SAPP: 96-102%, SAPP+PERT: 98-103%; 2yr: SAPP: 98-101%, SAPP +PERT: 97-101%), or any patient-reported outcome measure, all superior to outcomes reported in the literature.

## Discussion

Among women in the ACL-SPORTS randomized control trial, SAPP and SAPP+PERT training led to similar, very high 1 and 2 year outcomes in strength, function, patient-reported measures, and return-to-sport rates. Athletes across groups had symmetric strength and hop tests, high patient-reported outcomes, and 100% return-to-sport rates by 2 years, supporting the benefit of the common elements of the return-to-sport training program.