CHRONIC ankle instability (CAI) is a condition characterized by numerous ankle sprains and the recurring sensation of ankle instability, which result in activity limitations and participation restrictions.¹ Because a high percentage of ankle sprain cases are associated with residual functional deficiencies, there is a need to identify effective clinical interventions that address the long-term deficits associated with CAI. The purposes of this report are to present the findings of a randomized controlled trial that investigated the effect of balance training on postural control and self-reported function in patients with CAI and to provide clinical commentary about the use of balance training for the rehabilitation of CAI.

**Key Points**

- A four-week balance training program improved postural control in patients with CAI.
- A four-week balance training program increased self-reported function in patients with CAI.
- Dynamic balance exercises that emphasize recovery of balance following perturbation may be more effective than traditional balance training exercises.

**Study Purpose**

The McKeon et al. study was a randomized controlled trial that was performed for the purpose of examining the effect of a 4-week supervised balance training program on static and dynamic postural control and self-reported functional outcomes in participants with CAI.

**Summary of Methods**

This study included 31 individuals with self-reported CAI, who were randomly assigned to a balance training group (n = 16) or control group (n = 15). Subjects were included in the study if they reported a history of more than one ankle sprain, residual symptoms, and episodes of giving-way, which was operationally defined as four or more “yes” responses on the Ankle Instability Instrument. Additionally, subjects had scores of 90% or lower on the Foot and Ankle Disability Index (FADI) and the Foot and Ankle Disability Index Sport (FADI-S) surveys. The balance training group participated in 12 supervised balance training sessions over a 4-week period. The control group maintained the same level of activity they had reported prior to study enrollment.

Static postural control, dynamic postural control, and self-report function were quantified before and after the 4-week study period in both groups. Static postural control was
assessed through single-limb stance on a forceplate. Three 10-second trials were recorded with eyes-open and eyes-closed on each extremity. Center of pressure (COP) data was analyzed for both the eyes-open and eyes-closed conditions in the antero-posterior (AP) and medio-lateral (ML) directions. Dependent variables included the standard deviation (SD) of COP excursions, the range of COP excursions, and the mean velocity of COP excursions. Additionally, time-to-boundary (TTB) measures were derived from the COP data, which included absolute minimum, mean minima, and SD. TTB estimates the amount of time an individual has to make a postural correction to maintain balance. TTB is determined by calculating the instantaneous velocity and position of each COP point in relation to the border of the base of support in the direction of movement. The SD of TTB represents the amount of variability in postural control strategies that can be used to maintain single-limb stance.

Dynamic postural control was evaluated through maximum lower extremity reach distances for the Star Excursion Balance Test (SEBT). Three trials in the anterior, postero-medial (PM), and postero-lateral (PL) reach directions were recorded for each extremity, and the reach distances were normalized to the subject’s leg length. Self-reported function (FADI and FADI-S) was quantified at the time of subject enrollment and after the 4-week intervention period.

The progressive balance training program consisted of 12 supervised sessions over a 4-week period. Each session lasted approximately 20 minutes. During each session, subjects performed a series of dynamic balance activities that were designed to challenge recovery of balanced single-limb stance after a perturbation (Table 1). Each activity had seven levels of difficulty in which subjects individually progressed over the 4-week period. Participants were individually pro-

<table>
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<th><strong>Table 1. Balance Exercises Incorporated Into the Balance Training Intervention</strong></th>
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<td>Hop to stabilization</td>
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<td>Hop to stabilization and reach</td>
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<tr>
<td>(Unanticipated) hop to stabilization box drill</td>
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<td>Single-limb stance with eyes open</td>
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gressed through seven levels of task difficulty for each balance activity. Progression was based on the number of error-free repetitions performed at each level of task difficulty. Each balance activity had its own set of errors and a different number of error-free repetitions required for progression to the next level of difficulty. For example, 10 error-free repetitions of single-limb hop to stabilization were required to progress.

**Results and Relevance of Study Findings**

**Static Postural Control**

COP measurements with the eyes-open did not demonstrate any significant differences between groups following the 4-week intervention period. Both groups demonstrated a significant decrease in AP COP velocity. Although the eyes-open condition did not elicit any changes in postural control following balance training, several differences were noted in the eyes-closed condition. The balance training group demonstrated significant increases in several TTB measures and a significant decrease in COP velocity in the ML direction from pretest to posttest. The significant changes in TTB measurements indicate that the balance training program increased the amount of time and the number of possible strategies for postural corrections during single-limb stance. This suggests that the sensorimotor system is more capable of responding to perturbations in posture.

**Dynamic Postural Control**

The balance training group demonstrated significant improvement in reach distances on the SEBT in the PM and PL directions and significantly greater posttest values than those of the control group. Despite improvements in both posterior directions, no significant change was evident in the anterior direction. The increase in maximal reach distance indicates that balance training reduced the amount of constraint imposed on the sensorimotor system during performance of the task. The authors suggested that the lack of improvement in the anterior direction may relate to injury-related arthrokinematics and range of motion restrictions that were not affected by the balance training. Joint mobilization for increased posterior talar glide and greater dorsiflexion range of motion may provide a means to improve the anterior reach distance on the SEBT.
Self-Reported Functional Outcomes

There were no differences in the FADI or FADI-S scores between the groups at baseline assessment. Following the 4-week intervention period, the balance training group demonstrated significantly greater scores on both surveys. These findings indicate that balance training decreased activity limitations and participation restrictions.

Relevance to Clinical Practice

The results of this randomized controlled trial support the use of balance training for the rehabilitation of patients with CAI. This published research report presents a series of balance training exercises that athletic trainers and therapists can readily incorporate into their patients’ rehabilitation programs. Although previous studies have supported the use of balance training for prevention of recurrent ankle sprains,2,3 the McKeon et al. study provides higher quality level 1 evidence (Oxford Centre for Evidence-Based Medicine Levels of Evidence) to support the practice.

The balance training program used by this study emphasizes the recovery of single-limb stance following postural perturbations that are created by increasingly difficult tasks. Patients are progressed to increasingly difficult tasks on the basis of an error-count system. The results of this study suggest that challenging the sensorimotor system to recover from perturbations is an effective way to improve postural control. Some portion of the documented improvements in self-reported function may have resulted from sensorimotor system adaptations that were not captured by the chosen laboratory measurements. This study did not document a decrease in ankle sprain recurrence rate. Despite this limitation, the findings clearly support the use of dynamic balance training exercises to improve postural control in patients with CAI.

References


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