Wobble-Board Balance Intervention to Decrease Symptoms and Prevent Reinjury in Athletes With Chronic Ankle Instability: An Exploration Case Series

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Controlled research has shown that a single-exercise wobble-board intervention is effective at reducing symptoms and increasing function in patients with chronic ankle instability. However, the effectiveness of this protocol has not been documented in a realistic intercollegiate athletics environment. Eight intercollegiate athletes with chronic ankle instability participated in an 8-week (3 sessions/wk) wobble-board intervention. In a realistic environment, this simple intervention was feasible to implement and resulted in meaningful improvements in patient-reported stability for more than half of the patients (5 of 8) but only improved the global rating of function and pain for a minority of the patients (2 of 8 and 3 of 8, respectively). Not all patients experienced equal symptom reduction; however, no new ankle sprains occurred during the intervention.

Key Words: rehabilitation, ankle sprain, functional ankle instability, balance training

Ankle sprains are the most common injury in physically active populations and are especially prevalent in sports such as basketball and soccer. Short-term sequelae of ankle sprains include time lost from sport participation, pain, and loss of function. Long term, approximately 34% of individuals who sustain an acute lateral ankle sprain develop chronic ankle instability (CAI). Chronic ankle instability is characterized by ongoing instability and recurrent sprains after an acute lateral ankle sprain and can persist for years postinjury, resulting in decreased physical activity, disability, and posttraumatic osteoarthritis.

Researchers have detailed multiple interventions for decreasing symptoms, increasing function, and decreasing recurrent sprains in individuals with CAI. One such intervention, a wobble-board balance-training protocol, has shown promising results in multiple studies. Given the high patient volume and time constraints of providing clinical care in an athletic setting, this protocol has the advantage of being a simple, single-exercise intervention that can be completed independently by the patient in approximately 5 minutes using 1 piece of equipment. Researchers have shown improvement in patient-reported outcomes, clinical balance tests, and functional tests after completion of the 4-week intervention.

Typically, clinical trials have excluded participants who have acute ankle symptoms, have recently completed other ankle rehabilitation protocols, or are concurrently undergoing treatment for other injuries. These exclusion criteria attempt to control for the influence of potentially confounding variables and were appropriate for past study designs. However, they create a controlled laboratory setting that does not necessarily mimic the variability of real-life clinical situations. Clinicians do not have the option of selecting and treating only patients with isolated, uncomplicated injuries. Thus, an exploration of the effectiveness of this wobble-board protocol when applied in a live clinical setting is needed.

Ankle injury-prevention programs have been most effective in high-risk individuals (eg, those with a history of sprains). Therefore, we proposed to screen a population of university soccer and basketball athletes for a history of recurrent ankle sprains or instability (or both) and proactively assign those with CAI to the wobble-board protocol as a prophylactic treatment. However, to explore the intervention’s effectiveness in a clinically realistic (and ethical) manner, no one would be assigned to a no-treatment group, nor would the design limit the clinician’s judgment or flexibility in providing patient-centered care (eg, to assign additional exercises or treatment on an individual basis). Considering these factors, an exploration case series model was adopted. The purpose of an exploration case series is to provide practice-based evidence, systematically investigating factors related to the clinical presentation or resolution of injury. The specific purpose of the current case series was to document the effectiveness of a wobble-board balance intervention in reducing symptoms and sprains associated with CAI in a realistic intercollegiate athletic clinical setting.

CASE SERIES PRESENTATION

Patients

During preparticipation physical examinations, the athletic trainers (ATs) responsible for the clinical care of men’s soccer, women’s soccer, and men’s basketball at a National Collegiate Athletic Association Division III
during the in-season (~4 weeks) and continued during the in-season (~4 weeks), when they participated in normal team practices and conditioning. The modifications to the previously reported wobble-board protocol affected the protocol duration and dose. Past clinical trials used a duration of 4 weeks (dose = 12 sessions).8–10 However, the individuals supervising the current case series felt 4 weeks might be insufficient and elected instead to explore an 8-week duration (dose = 24 sessions). Thus, case series patients were assigned to complete 3 sessions a week for a minimum of 8 weeks. To facilitate comparisons with previous research, we obtained patient-reported outcomes after both 4 and 8 weeks to compare the effects of the 4-versus 8-week duration.

For each session, patients stood on the involved limb on a wobble board placed near a wall (Figure). They completed five 40-second sets of clockwise and counterclockwise rotations (alternating direction every 10 seconds), with up to 60 seconds of rest between sets. Counterclockwise and counterclockwise rotations involved the patient using the ankle to tilt the wobble board circularly in a slow and controlled manner. Patients could place their fingers on the wall for stability. Training was started at the lowest level (level 1 of 5) of the wobble board, and progression was based on the patient’s ability to complete smooth circular rotations in both directions and smooth transitions between direction changes. Generally, a session took approximately 5 minutes, and progressions were implemented once a week.8 A single clinician (C.J.W. [certified for 12 years]) provided initial instruction on the wobble-board protocol to each patient. For the 8 weeks after the initial session, patients were monitored by their supervising AT, with clinician feedback as appropriate. The 2 supervising ATs (J.C.B. [certified for 13 years] and S.L.N. [certified for 8 years]) were trained in this protocol by the primary investigator (C.J.W.).

In keeping with the aim of this clinical case series to explore the effectiveness of the wobble-board intervention in a clinically realistic setting, patients were not restricted from completing any additional rehabilitation or treatment that their supervising AT deemed necessary for either their CAI or other lower extremity injury. However, the presence or absence of any additional interventions was documented (Table 2). Also, the use of prophylactic ankle braces or taping was documented each week for the duration of the intervention (Table 2), as both have been shown to reduce the risk of ankle injury in individuals with a history of ankle sprains.21

Table 1. Patient Demographics

<table>
<thead>
<tr>
<th>Case</th>
<th>Sport</th>
<th>Sex</th>
<th>Involved Side</th>
<th>Years Since First Sprain</th>
<th>Severity of First Sprain</th>
<th>Lifetime Resprains, No.</th>
<th>Giving-Way Episodes (Last 6 mo)</th>
<th>Cumberland Ankle Instability Tool Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Soccer</td>
<td>Female</td>
<td>Right</td>
<td>5</td>
<td>Grade 1</td>
<td>3</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>Soccer</td>
<td>Female</td>
<td>Right</td>
<td>4</td>
<td>Grade 1</td>
<td>2</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>Soccer</td>
<td>Female</td>
<td>Right</td>
<td>7</td>
<td>Grade 1</td>
<td>2</td>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>Soccer</td>
<td>Female</td>
<td>Right</td>
<td>2</td>
<td>Grade 2</td>
<td>2</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>Soccer</td>
<td>Male</td>
<td>Left</td>
<td>1</td>
<td>Grade 3</td>
<td>0</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>Soccer</td>
<td>Male</td>
<td>Right</td>
<td>1</td>
<td>Grade 3</td>
<td>1</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>7</td>
<td>Basketball</td>
<td>Male</td>
<td>Left</td>
<td>4</td>
<td>Grade 3</td>
<td>2</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>Basketball</td>
<td>Male</td>
<td>Left</td>
<td>6</td>
<td>Grade 3</td>
<td>1</td>
<td>1</td>
<td>22</td>
</tr>
</tbody>
</table>

All 8 patients with CAI were assigned by their supervising clinician to a standardized wobble-board protocol (modified from the methods of Linens et al8). All patients started the intervention during the preseason (~4 weeks) and continued during the in-season (~4 weeks), when they participated in normal team practices and conditioning. The modifications to the previously reported wobble-board protocol affected the protocol duration and dose. Past clinical trials used a duration of 4 weeks (dose = 12 sessions).8–10 However, the individuals supervising the current case series felt 4 weeks
number of days out of sport participation entirely and time restricted as the number of days until clearance for full participation.

Before the intervention (week 0), at the halfway point (week 4), end (week 8), and 1-month postintervention (week 12), each patient was asked to provide an ankle-specific global rating of function (GRF), stability, and pain. During the 4-week postintervention period, the patient ceased performing the wobble-board protocol but continued with normal team activities (ie, games, practices, conditioning) and any other assigned rehabilitation exercises.

Perceived ankle stability was recorded on a scale of 0 (very unstable) to 10 (very stable). Again, the MCID and MDC for this measure have not been established. However, stability improvements of 1.7 to 2.1 points while completing functional tasks (eg, side hop or figure-of-8 hop) have been reported after a similar wobble-board protocol.8 Using these values as the best available evidence, we set 2 points as the threshold for meaningful improvement.

The GRF was recorded on a scale from 0 to 100, with 0 = no use of your ankle (cannot put weight on it at all) and 100 = full use of your ankle (not limited at all). The minimally clinically important difference (MCID) and minimal detectable change (MDC) have not been established for the GRF. Among patients with CAI who were enrolled in a similar wobble-board protocol, the GRF improved by 11.7 points (95% confidence interval [CI] = 4.6, 18.8).8 Using this value, we set 5 points (lower end of the CI) as the threshold for meaningful improvement in our case series.

Ankle-specific pain was recorded using the numeric pain rating scale of 0 (no pain) to 10 (worst pain imaginable). The MCID for this scale in patients with chronic musculoskeletal pain is 2 points (ie, a decrease of 2 points is associated with patients reporting that their condition is “much better” on the global impression of change scale)22; therefore, a decrease in pain of 2 points was considered meaningful in this case series.

### COMPARATIVE OUTCOME AND RESULTS

Eight patients started and completed the intervention. Individual characteristics are reported in Table 1. In summary, 6 patients were soccer athletes (4 females, 2 males), and 2 were basketball athletes (2 males). The initial ankle sprains were 3.8 ± 2.3 years prior, and most patients sought medical attention (n = 7, 88%). Subsequently, they reported an average of 1.9 ± 1.0 resprains and 4.6 ± 5.6 episodes of giving way in the past 6 months; they scored an average of 19.3 ± 3.2 on the CAIT. Descriptive data of each patient’s reported outcomes at intake and weeks 4, 8, and 12 are provided in Table 3.

### Stability

Using a threshold score of 2 points, we found that after both 4 and 8 weeks, stability was improved in 3 patients, worse in none, and the same in 5. At week 12, stability was improved in 5 patients, worse in none, and the same in 3. Patients who started with the least stability saw the greatest improvements. Six patients started with clinically meaningful stability deficits (>2 points), and all 6 experienced clinical improvement. Of these six, 2 had no additional rehabilitation, bracing, or taping; 2 had additional taping only; and 2 had both additional rehabilitation and taping or...
bracing. Two patients used a brace throughout the entire intervention; 1 improved in stability, and 1 did not. Two patients used taping throughout the entire intervention; both improved in stability.

**Global Rating of Function**

After 4 weeks, using a threshold score of 5 points, we noted that GRF was improved in 1 patient, worse in 1 patient, and the same in 6 patients. After 8 weeks of treatment, GRF was improved in 2 patients, worse in 1 patient, and the same in 5 patients. At week 12, GRF was improved in 3 patients, worse in 2 patients, and the same in 3 patients. Patients who started with a lower GRF (≤95) tended to experience improvements. Patients who started with a high GRF (>95) tended to report small fluctuations (eg, 99, 95, and 99 again). Only 3 patients reported meaningful improvements in GRF. None of these 3 were reassigned additional ankle stabilization (1 did additional rehabilitation for another lower extremity injury). One wore an ankle brace, and another taped during the entire 8 weeks. Two of these 3 also experienced meaningful improvements in stability, and only 1 experienced a meaningful improvement in pain.

**Pain**

After 4 weeks, using a MCID of 2 points, we noted that pain was improved in 3 patients, worse in none, and the same in 5. After the full 8-week intervention, pain was improved in 3 patients, worse in 2, and the same in 3. At week 12, pain was improved in 4 patients, worse in 1 patient, and the same in 3 patients. All patients who started with pain >2 experienced large and consistent improvements. Patients who started with pain ≤2 experienced small fluctuations (typically 1–2 points) either for better or worse throughout the 12-week period. Two patients started with clinically meaningful pain scores (>2), and both experienced clinical improvement. Neither of these 2 patients completed additional rehabilitation or used bracing, but they were the only individuals who elected to tape their ankles daily for all 8 weeks.

**Rehabilitation Compliance and Injury Outcomes**

No ankle sprains were reported during the 8-week intervention (Table 4). Thus, no patients lost time due to ankle sprains. Three patients had time-loss injuries unrelated to the involved ankle (1 concussion, 1 thumb sprain, 1 midfoot pain). These injuries did not cause clinically meaningful changes in stability, GRF, or pain. Patient compliance with the assigned rehabilitation sessions was high (95% ± 8%, range = 83%–100%; Table 4). Three patients were assigned additional ankle rehabilitation by their supervising AT, and 3 patients completed rehabilitation for other lower extremity injuries. For prophylaxis, taping was more common (4 patients) than bracing (3 patients). Some patients taped or braced during the entire 8 weeks of treatment, while others used external support for only 1 to 2 weeks.

**DISCUSSION**

The purpose of our case series was to explore the effectiveness of a wobble-board balance intervention in reducing the symptoms and sprains associated with CAI in a realistic clinical setting. To our knowledge, this is the first time this particular wobble-board protocol has been implemented as a prospective case series intervention in a realistic clinical setting using patient-oriented measures as the primary outcome of interest. Comparisons between the current case series and past controlled research add to clinicians’ evidence base.

**Symptom Reduction**

We chose to use 3 patient-oriented outcomes as our primary measures of symptom reduction. Overall, we found the most meaningful improvement in stability; a pattern toward decreased pain, and no meaningful change in GRF. Specifically, at 4 and 8 weeks, stability increased in 37.5%
of patients and remained the same in 62.5% of patients, but by 12 weeks, those numbers had reversed to improvement in 62.5% and no change in 37.5% of patients. The increased length of this explorational case study (8 weeks of training) compared with previous research (4 weeks) did not result in immediate improvements in stability. This may reflect a ceiling for the dose response. However, short-term follow up (12 weeks) revealed that not only did 3 patients maintain improvements, 2 additional patients experienced meaningful improvements after the end of the training period. Although improvement in these 2 individuals could be interpreted as continuing effects of the training protocol even after its cessation, we believe it is more likely that the variability between stability ratings at 8 and 12 weeks highlights the normal highs and lows (both physically and psychologically) of an athletic season. Our findings at 12 weeks provide limited support for the possibility that longer treatment or follow-up durations may be necessary in the less controlled clinical setting to increase perceived stability independent of seasonal fluctuations.

Perhaps not surprisingly, patients who started with the least stability saw the greatest improvements. To conserve resources and maximize results, clinicians should target wobble-board interventions at individuals with low self-reported stability. Clinicians may consider alternative interventions in individuals starting with self-reported high stability. Stability ratings in the current case series were much higher than previously reported in physically active individuals with CAI. This likely reflects the fact that our patients were university athletes and thus presumably able to cope with ankle instability at least enough to maintain their position on the team.

Past researchers reported GRF improvements of 11.7% (82.2% at preintervention to 93.4% at postintervention), which were maintained for at least 6 months postintervention. In contrast, at 12 weeks, we found little support for meaningful GRF improvements (3 patients improved, 3 had no change, 2 were worse). The number of patients who were categorized as improved increased by 1 at each time point (1 at week 4, 2 at week 8, and 3 at week 12). This provides limited evidence for a dose response related to GRF that we did not see for measures of stability.

We operationally defined a meaningful GRF change as ≥5 points; however, future investigators should establish the MDC and MCID of this measure to facilitate comparisons of preintervention and postintervention scores. Despite the ambiguous results for GRF, 1 trend was clear: patients who started with a lower GRF (≤95) tended to experience fairly steady improvements, while patients who started with a higher GRF (>95) were more likely to report small fluctuations in either direction. This highlights an obvious ceiling effect of the GRF measure. However, it also directs clinicians aiming to use resources effectively to target rehabilitative efforts at individuals with initially low self-reported GRFs.

Lastly, at 12 weeks, 4 patients experienced meaningful decreases in pain; only 1 patient experienced an increase, and 3 experienced no change. As our patients were participating in intercollegiate athletics during this case series, self-reported ankle pain was likely influenced by seasonal wear and tear in addition to the intervention itself. Again, the trend continued: patients who started with the largest room for improvement (pain score >2) experienced large and consistent improvements, while those who started with little pain (≤2) experienced small fluctuations below the MCID. Thus, the current protocol was effective in decreasing pain only for patients with pain scores >2. Clinically, a 50% success rate is not ideal but may improve if future applications of this protocol target patients who initiate treatment with pain scores >2. For patients unlikely to achieve pain reduction with the current wobble-board protocol, modified or alternative interventions should be studied.

We noted 2 important trends across all patient-reported outcomes: (1) patients with greater deficits saw greater improvements regardless of the measure (stability, GRF, or pain) and (2) patients’ initial symptoms and responses to the intervention were highly individual (eg, some had deficits in stability but not pain, some saw improvements in pain but not GRF, some reported deficits in pain only). Researchers proposed an assess-treat-reassess paradigm for individuals with CAI that emphasizes the need to target the areas of greatest deficit and customize the treatment of individuals with CAI. The trends we noted provide limited support for moving toward an individualized model. However, in some clinical settings, an individualized prevention program may not be feasible; thus, we believe there is still a role for this standardized wobble-board intervention in improving patient outcomes.

Recurrent Sprains

No recurrent ankle sprains were reported during the 8-week study period. Because this was a case series, we could not calculate an internal control injury rate for comparison from a control group. Injury rates for collegiate men’s soccer, women’s soccer, and men’s basketball average 1.28 ankle ligament sprains per 1000 athlete-exposures. The exact number of athlete-exposures was not tracked in the current study, but athlete-exposures were approximately 500. Using these numbers, we estimate 0 or 1 new sprains as the control rate and, thus, our findings would appear unremarkable.

However, this case series enrolled only individuals with CAI, who are known to have a higher risk of recurrent sprains. Among high school basketball and soccer players, the overall ankle-sprain rate in control participants (1.87 per 1000 exposures) doubled in individuals with a history of ankle sprain. These data would lead us to expect approximately 2 sprains during the current intervention and, therefore, the finding of 0 sprains appears more meaningful. When viewed in light of injury incidence data for individuals with CAI, our results provide limited clinical evidence that the wobble-board intervention may have contributed to a reduction in ankle sprains. From the perspectives of the clinicians and individual patients involved in this case series, a season without ankle injury was a positive outcome.

Clinical Observations

One potential barrier to investigating treatment efficacy in collegiate athletes is (understandable) reticence by individual clinicians to use strictly controlled treatment protocols. Such protocols could violate the principles of evidence-based practice if adherence to the protocol overrides the clinician’s expertise when treating an
individual patient. For that reason, we conducted an exploration case series that used the wobble-board intervention of interest while allowing the supervising ATs to assign additional rehabilitation or treatments (such as taping or bracing) on an individual basis. These student-athletes were also engaged in regular vigorous activity, which involved some uncontrollable risks (eg, contact injuries), during the case series intervention. We believe the case series approach retained the important dynamics of a real clinical environment and, thus, our findings are directly applicable to university athletic settings.

The wobble-board intervention uses a single exercise that can be completed by the patient with minimal clinician oversight and using cost-effective equipment. Past researchers claimed that these features would make it feasible to implement in an athletic setting. The experience of the clinicians involved in the current case series was that the protocol was indeed feasible and low cost (requiring only a standard wobble board, which initially cost approximately $200) and that implementing it added minimally to their workload, even in a busy university athletic training clinic. Anecdotally, since we stopped enrolling patients in this case series, the wobble-board intervention continues to be prescribed in this athletic training clinic for athletes with a history of ankle sprains or instability.

Considerations for Future Scientific Investigations and Practice-Based Recommendations Based on the Current Findings

This intervention was designed a priori as an exploration case series, the purpose of which was to explore the effectiveness of a wobble-board intervention in a realistic intercollegiate athletic clinical environment. Thus, some variables that might have affected intervention effectiveness (eg, other concurrent rehabilitation, bracing) were not controlled. Although they were tracked (Table 2), it is not possible to separate their exact contributions to the overall results. Additionally, this case series enrolled 8 patients. Although the trends we found support the effectiveness of this wobble-board intervention for improving stability and decreasing pain (but not improving GRF) in a realistic clinical environment, additional evidence is needed. In particular, future investigators should further explore a dose response to treatment and target individuals who have the greatest potential for benefit (eg, those with worse stability, GRF, and pain).

Lastly, previous authors who used this wobble-board protocol assessed both patient-oriented outcomes and measures of balance and agility, whereas we elected to evaluate only patient-oriented outcome measures that could be collected quickly and easily in a clinical setting. We could compare our findings with previously reported scores, but 2 of our measures (stability and GRF) lack established MCID or MDC values (or both). Future researchers should validate their utility in assessing meaningful clinical change. Additionally, the effectiveness of this protocol applied in a realistic clinical environment on measures of balance and agility should be explored.

CLINICAL BOTTOM LINE

The current case series explored the effectiveness of a wobble-board training intervention applied in a realistic clinical environment for decreasing patient-reported symptoms and potentially decreasing ankle-sprain reinjuries in collegiate athletes with CAI. This simple, single-exercise intervention was feasible to implement and effective in improving stability and, to a lesser degree, pain but not GRF. Not all patients experienced equal benefit; those with poorer initial scores experienced the greatest improvement. From an individual patient perspective, the lack of ankle-sprain reinjuries during the competitive season provided limited evidence for the intervention’s merit.

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