The Effect of Plyometric Training on Peroneal Latency

Benjamin Henry, Todd McLoda, Carrie L. Docherty, and John Schrader

Context: Peroneal reaction to sudden inversion has been determined to be too slow to overcome the joint motion. A focused plyometric training program may decrease the muscle’s reaction time. Objective: To determine the effect of a 6-wk plyometric training program on peroneus longus reaction time. Design: Repeated measures. Setting: University research laboratory. Participants: 48 healthy volunteers (age 20.0 ± 1.2 y, height 176.1 ± 16.9 cm, weight 74.5 ± 27.9 kg) from a large Midwestern university. Subjects were randomly assigned to either a training group or a control group. Interventions: Independent variables were group at 2 levels (training and no training) and time at 2 levels (pretest and posttest). The dependent variable was peroneal latency measured with surface electromyography. A custom-made trapdoor device capable of inverting the ankle to 30° was also used. Latency data were obtained from the time the trapdoor dropped until the peroneus longus muscle activated. Peroneal latency was measured before and after the 6-wk training period. The no-training group was instructed to maintain current activities. The training group performed a 6-wk plyometric protocol 3 times weekly. Data were examined with a repeated-measures ANOVA with 1 within-subject factor (time at 2 levels) and 1 between-subjects factor (group at 2 levels). A priori alpha level was set at P ≤ .05. Main Outcome Measures: Pretest and posttest latency measurements (ms) were recorded for the peroneus longus muscle. Results: The study found no significant group-by-time interaction (F_{1,46} = 0.03, P = .87). In addition, there was no difference between the pretest and posttest values (pretest = 61.76 ± 14.81 ms, posttest = 59.24 ± 12.28 ms; P = .18) and no difference between the training and no-training groups (training group = 59.10 ± 12.18 ms, no-training group = 61.79 ± 15.18 ms; P = .43). Conclusions: Although latency measurements were consistent with previous studies, the plyometric training program did not cause significant change in the peroneus longus reaction time.

Keywords: muscle activation, peroneus longus, trapdoor, reaction time

Fifty percent of the general population will experience at least 1 ankle sprain in their lifetime. In addition, about 20% of patients with an acute sprain will remain...
symptomatic because of inappropriate or delayed rehabilitation. In athletes, the most common injury that occurs is a lateral ankle sprain, representing 15% to 20% of all sport injuries. Lateral ankle sprains are most often caused by forced inversion and plantar flexion. The lateral ankle musculature has a reactive component that has the potential to help prevent inversion ankle injuries. Because inversion ankle sprains are so prevalent, understanding the mechanics of this injury and how the body involuntarily adapts to correct potentially damaging moments can help professionals develop better injury-prevention strategies.

Reflexes are involuntary responses that link afferent (sensory) and efferent (motor) signals. A stretch reflex occurs when a muscle is rapidly stretched. The stretch reflex is made up of 3 significant activations: M1, M2, and M3. M1, also known as the short latency or short loop reflex, occurs approximately 60 milliseconds after sudden stretch. This is the first response to sudden ankle inversion, but the reflex creates very minimal increase in muscle torque. M2, also known as medium latency reflex, occurs after 70 to 90 milliseconds and travels along slower conducting afferents. The afferent response is sent to the motor cortex of the brain. M3, or the long latency loop, may not always occur, but it serves to continue motoneuron stimulation sequentially followed by activation of voluntary torque at approximately 150 to 170 milliseconds after the onset of unexpected ankle stretch. For activation of each motor unit in the muscle, a certain excitatory input of activity is required. During a stretch reflex, stimulations by means of M1, M2, and M3 are combined on the previous, therefore creating an increase in motoneuron excitability. M3 leads to voluntary torque production, in which the reflex is initiated by activation of Ia-afferent sensory fiber recruited in M1. It is hypothesized that the shorter the muscle reaction latency, the better the ability to correct posture and prevent injury to the lateral ankle ligaments.

Numerous studies have been conducted on the reaction time of the peroneal musculature. Previous investigations have shown that the peroneal muscles can decelerate a potentially damaging inversion moment, minimizing injury to the lateral ankle structures. Eechaute et al recorded 2 deceleration points that can decrease the momentum of the inversion perturbation: one between 31 and 35 milliseconds, and the other between 104 and 106 milliseconds. These deceleration points work as a resistance to the inversion stress to correct the detected motion. That study also showed activation of the peroneal muscle 62 to 65 milliseconds after the sudden inversion moment. This M1 muscle reaction is the first protective mechanism the ankle musculature creates after a sudden inversion perturbation, in which the muscle contracts, but not to the point of joint movement. Prior studies have shown that previous injury to the peroneal muscles can lead to an increased incidence of lateral ankle sprains by delaying muscle activation.

Conversely, reports by Isakov et al and Thonnard et al state that the reaction time of the peroneal muscles may not be fast enough to protect the ankle from a sudden unexpected inversion injury. This is supported by a study by Konradsen et al, which showed that the initial electromyographic activity of the peroneus longus occurred 54 milliseconds after sudden ankle inversion, but voluntary active eversion did not occur until 176 milliseconds after sudden inversion. Inversion from a standing position would put the lateral ankle structures in danger after approximately 100 milliseconds, therefore making reflexive and voluntary motions too slow to prevent injury to the lateral ligaments of the ankle. In addition, during
a dynamic task, injury may occur even faster as a result of increased forces at the joint.\textsuperscript{16} However, the muscles are preactivated during dynamic activity so the reaction to unexpected inversion may also be faster.\textsuperscript{29}

Improving the reaction time of the peroneal muscles may enhance the protective reflexive mechanism, thus reducing the risk of sudden inversion ankle injury.\textsuperscript{16} Plyometric training has been used for lower extremity muscle control and stability.\textsuperscript{30–37} This type of training emphasizes the stretch–recoil principle but also affects joint-position sense,\textsuperscript{31,33} balance,\textsuperscript{31} and coordination throughout functional movement.\textsuperscript{35} Plyometric training has been shown to cause an adaptation of the stretch reflex and improve reaction times of the lower extremity.\textsuperscript{30,34} Studies have concluded that after training dynamic movement patterns, muscles react faster to sudden unexpected perturbations.\textsuperscript{30,34} In addition, plyometric training has also shown increases in the output of power and explosiveness by training functioning muscles to maximize muscle contraction in a shorter amount of time.\textsuperscript{32} This occurs when the stretch–recoil cycle is working optimally, decreasing the amortization phase and rapidly transitioning from the eccentric muscle contraction to a concentric muscle contraction.\textsuperscript{32} Plyometric training can also produce increased torque.\textsuperscript{37} Cornu et al\textsuperscript{37} concluded that a 7-week plyometric training program incorporating squat jumps, drop jumps, and jumping courses led to significant gains in maximal isometric torque of the ankle plantar flexors. They hypothesized that the faster and more efficient the muscles are in the amortization phase, the better the reflex response will be.\textsuperscript{37} In addition, by maximizing the force produced during the concentric phase of a muscle contraction, plyometric exercises can increase joint stability.\textsuperscript{32} Plyometric training has been shown to increase lower limb stability by improving muscle activation.\textsuperscript{32,35} Plyometric training protocols have resulted in an increase in joint stability in the lower extremity by increasing preparatory muscle activity,\textsuperscript{35} as well as reducing lower extremity valgus motion during landing.\textsuperscript{31}

Improving reflexive muscle activation during sport-specific activities could decrease the reaction time during sudden damaging movements. We hypothesized that the earlier M1 reflex occurs, the sooner voluntary muscle activation can occur, and that improving the reaction time of the peroneal muscles may reduce the risk of ankle injuries.\textsuperscript{4,6–9} Therefore, the purpose of this study was to determine whether a 6-week functional plyometric training program can be used to reduce the reaction time of the peroneal muscles in healthy subjects.

**Methods**

**Research Design**

The study was a pretest–posttest experimental design. The independent variables were plyometric training group at 2 levels (training and no training) and time at 2 levels (pretest and posttest). The dependent variable was peroneus longus latency.

**Subjects**

Forty-eight college students from a large Midwestern university volunteered to participate in this study (Table 1). To be eligible for this study, subjects had to participate in physical exercise for at least 3 days a week for 30 minutes at a time. Subjects
were excluded if they had a history of an ankle sprain in the past 12 months or any history of ankle surgery or fracture. Subjects were randomly assigned to either the training group or the no-training group. Both groups had an equal number of male and female subjects. Before participating in this study, all subjects read and signed an informed-consent form approved by the university’s Institutional Review Board for the Protection of Human Subjects, which also approved the study.

**Instrumentation**

Peroneal latency was measured by using the Biopac Systems MP150 with telemetry system TEL100M and TEL100C (Biopac Systems Inc, Goleta, CA). Surface pregelled Ag-AgCl, vinyl tape, 35-mm-diameter disposable surface electrodes were used. Electromyography (EMG) data were collected through a remote amplifier at a sampling rate of 1250 Hz. Each EMG channel was filtered through a band-pass filter of 10 to 350 Hz. A custom-made trapdoor capable of inverting the ankle to 30° was also used. The angle of 30° was selected because it did not cause harm to the soft-tissue structures of the joint but still permitted a study of the muscle reactions during unexpected inversion. A TSD130 twin-axis goniometer (Biopac Systems) was attached to the trapdoor to record its first movement. According to previous studies, using EMG with a trapdoor mechanism is common practice when assessing peroneal latency.23,38,39

**Pretest Procedures**

The dominant limb was used for all testing procedures. Dominant limb was determined by asking which leg the subject would prefer as the kicking limb when kicking a soccer ball. Surface electrodes were placed on the subject according to a study by Benesch et al.4 Peroneus longus electrodes were placed 3 cm below the head of the fibula, and a ground electrode was placed on the lateral malleolus. The sites were prepared with 220-grit sandpaper and shaved and cleaned with 70% isopropyl alcohol to remove oil or lotion and reduce skin impedance.

For the peroneal latency procedures, each subject stood barefoot on the trapdoor device. Subjects were instructed to focus on an X placed on the wall at eye level and to support their full weight on the dominant leg. A wooden block 15 cm high was placed beneath the contralateral limb to ensure almost full weight bearing on the test leg (Figure 1). In this position, the contralateral limb acted primarily to maintain equilibrium.

Subjects were positioned with their backs to the investigator to eliminate visual cues. To remove auditory cues, they wore headphones. Once the subject was relaxed, the trapdoor was released at a random interval. Time between drops

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic Information, Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>Gender</td>
</tr>
<tr>
<td>No training (n = 24)</td>
<td>12 male, 12 female</td>
</tr>
<tr>
<td>Training (n = 24)</td>
<td>12 male, 12 female</td>
</tr>
</tbody>
</table>
varied between 5 and 20 seconds. Each subject performed a practice trial followed by 5 test trials.\textsuperscript{5,17,18,27}

**Training Procedures**

The no-training group was instructed to maintain their current activity level for a 6-week period. The training group performed a 6-week plyometric training protocol at 3 different levels. Each level was 2 weeks in length. Weeks 1 and 2 involved plyometric jumps, weeks 3 and 4 involved 4-square drills, and weeks 5 and 6 incorporated both plyometric jumps and 4-square drills that were more advanced than the previous exercises. Each training session consisted of a 5-minute cardiovascular warm-up on a stationary bike at a moderate speed with low resistance, followed by a 15-minute plyometric exercise protocol. Subjects were asked to perform the plyometric exercises at maximal intensity. The plyometric training occurred 3 times per week, with no less than 24 hours between sessions. All training sessions were supervised and timed by the primary investigator. Compliance rates for all subjects in the training group were equal to or greater than 78\%, or 14/18 sessions.

**Level 1—Plyometric Jumps.** During level 1, each participant went through 5 exercise jumping stations (Table 2). Each exercise was demonstrated by the investigator. The exercises included split squats, wall touches, tuck jumps, sprint strides, 12-in. box jumps, and 12-in. hurdles. After each set, the participant rested for 30 seconds. These exercises were adopted from a protocol created by Chu\textsuperscript{40} and used by Rahimi and Behpur\textsuperscript{32} and Myer et al.\textsuperscript{31}
Level 2—4 Square Drills. Level 2 required the use of jumping quadrants. The quadrants were labeled 1 through 4 in a clockwise direction, starting with the lower left box (Figure 2). The jumping pattern for this level is documented in Table 3. The beginning and conclusion of each jumping pattern was controlled.

Table 2  Level 1 Plyometric Jumps Protocol

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Sets × Repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Split squats</td>
<td>6 × 10</td>
</tr>
<tr>
<td>Wall touches</td>
<td>5 × 10</td>
</tr>
<tr>
<td>Tuck jumps</td>
<td>5 × 10</td>
</tr>
<tr>
<td>Sprint strides</td>
<td>3 × 50</td>
</tr>
<tr>
<td>12-in. box jumps</td>
<td>3 × 20 s</td>
</tr>
<tr>
<td>12-in. hurdles (10 hurdles)</td>
<td>5 × 10</td>
</tr>
</tbody>
</table>

Figure 2 — Jumping quadrant used in the plyometric training sessions.

Table 3  Level Two 4-Square Jump-ing Protocol, Performed With Both Feet and on Each Individual Limb

<table>
<thead>
<tr>
<th>Exercise</th>
<th>4-square jump</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1, 2</td>
</tr>
<tr>
<td>2</td>
<td>1, 4</td>
</tr>
<tr>
<td>3</td>
<td>1, 3</td>
</tr>
<tr>
<td>4</td>
<td>2, 4</td>
</tr>
<tr>
<td>5</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>6</td>
<td>1, 2, 4</td>
</tr>
<tr>
<td>7</td>
<td>4, 2, 1</td>
</tr>
<tr>
<td>8</td>
<td>4, 3, 1</td>
</tr>
</tbody>
</table>
by the investigator. Participants engaged in each of the 8 jumping patterns for 20 seconds with both limbs. Then, they repeated the 8 jumping patterns on each limb individually for 10 seconds per limb. After each exercise, the participants rested for 30 seconds. The subjects were reminded of proper form during training protocol. Proper form was defined as (1) feet leaving the ground, not sliding across it; (2) knees slightly bent; (3) jumping action on the balls of the feet; and (4) eyes up, not looking at the floor.

**Level 3—Advanced Drills.** For level 3, a combination of advanced plyometric drills and 4-square drills was used. These drills were more demanding than in the previous levels. The exercises for this level are documented in Table 4. They included lateral single-leg alternating push-offs, the 90-second drill, 18-in. box jumps, and 4 bilateral-limb 4-square drills incorporating memory and multidirectional movements. Each exercise was demonstrated by the investigator. After each exercise, participants rested for 30 seconds. These exercises were also adopted from a protocol created by Chu and used by Rahimi and Behpur and Myer et al.

**Posttest Procedures**

The posttest peroneal latency measurements were recorded in the same method as the pretest, 1 to 3 days after the final training session. The posttest for the no-training group was 6 weeks after their pretest.

**Data Processing**

EMG data were rectified after they were collected. Latency data were processed by MATLAB (The MathWorks, Inc, Natick, MA). Peroneus longus latency values were calculated from 2 separate points. The first point was the trapdoor movement, identified by the first point 3 standard deviations above a 2-second quiet segment before trapdoor drop on the recorded goniometer channel. The second point was peroneus longus activation, identified by the first point 10 standard deviations above a mean 1-second quiet segment before activation. This method has been shown as the most reliable in previous studies. The means of the 5 trials for the pretest and posttest were used for statistical analysis.

**Table 4 Level 3 Advanced Drills**

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Sets × Repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral single-leg alternating push-offs</td>
<td>3 × 20</td>
</tr>
<tr>
<td>90-s box drill</td>
<td>5 × 15</td>
</tr>
<tr>
<td>18-in. box jumps</td>
<td>3 × 20 s</td>
</tr>
<tr>
<td>4-square—1, 2, 3, 4, 3, 2, 1</td>
<td>1 × 20 s</td>
</tr>
<tr>
<td>4-square—1, 3, 2, 4</td>
<td>1 × 20 s</td>
</tr>
<tr>
<td>4-square—2, 3, 1, 4</td>
<td>1 × 20 s</td>
</tr>
<tr>
<td>4-square—4, 1, 3, 2</td>
<td>1 × 20 s</td>
</tr>
</tbody>
</table>
Statistical Analysis

Data were examined with a repeated-measures analysis of variance with 1 within-subject factor (test at 2 levels: pretest and posttest) and 1 between-subjects factor (group at 2 levels: training and no training). The alpha level was set a priori at $P \leq .05$.

Results

Means and standard deviations are listed in Table 5. We found no significant group-by-time interaction ($F_{1,46} = 0.03$, $P = .87$, $\eta^2_p = .01$, $1 - \beta = .53$), no significant difference between the pretest and posttest ($F_{1,46} = 1.86$, $P = .18$, $\eta^2_p = .039$, $1 - \beta = .27$), and no significant difference between the training and no-training groups ($F_{1,46} = 0.64$, $P = .43$, $\eta^2_p = .01$, $1 - \beta = .12$; Figure 3).

Discussion

The focus of this study was to determine whether a 6-week plyometric training program would decrease peroneus longus muscle latency. Cornu et al\textsuperscript{37} previously reported that plyometric training may increase stretch-reflex activity. Therefore, we hypothesized that recreating stress at the ankle with plyometric training in

| Table 5  Peroneus Longus Muscle Activation Latency for Pretest and Posttest (N = 48), Mean ± SD |
| -------- | --------------------------------- | --------------------------------- |
| Group    | Pretest (ms)                      | Posttest (ms)                    |
| No training | 62.9 ± 15.7                      | 60.7 ± 14.1                      |
| Training  | 60.5 ± 14.0                      | 57.6 ± 10.2                      |

Figure 3 — Peroneal muscle latency data ($F_{1,46} = 0.03$, $P = .87$, $\eta^2_p = .01$, $1 - \beta = .53$, $P < .05$).
multiple planes of motion would not only increase the stretch-reflex activity but also subsequently decrease the time it takes for this involuntary muscle reaction to occur. However, the primary finding of our study was that subjects who underwent a 6-week plyometric training program had no change in peroneal latency.

Data on peroneal latency in the current study were consistent with previous studies. We found mean latency measurements for the pretest ranging from 61 to 63 milliseconds. For the posttest, mean latency values were 61 milliseconds for the no-training group and 58 milliseconds for the training group. Previous studies investigating peroneal latency recorded values ranging from 59 to 79 milliseconds. The range of peroneal latency values in previous studies could be a result of differences in electrode placement, type of trapdoor apparatus, or method of calculating latency value.

We know that by using training methods, we can change the mechanics of the lower limb, but there are differences in previous studies that could cause conflicts in study comparison. One potential explanation for our lack of significant differences after the training protocol may be the subjects used in the study. We tested asymptomatic subjects, without any acute symptoms of an inversion ankle sprain. This may have created a ceiling effect, thereby reducing the impact the training could have on peroneal latency. With no acute symptoms of an inversion ankle sprain, these subjects may not have had the opportunity to improve their reaction time. When training exercises are used as part of a functional rehabilitation protocol after a sudden inversion injury, decreased peroneal reaction time may be present because of the injury. It is possible that because no deficit in peroneal latency was present in the test population, no improvement in peroneal latency could be observed. Because neuromuscular pathways are damaged during an inversion ankle sprain, we know that a decreased reflexive response is seen, providing the basis for this type of rehabilitation exercise. In a population with chronic ankle instability, Eils and Rosenbaum showed a significant decrease in peroneus longus reaction time after a 6-week proprioceptive rehabilitation program.

In a controlled laboratory setting, visual and vestibular cues are eliminated to standardize the inversion perturbation. However, during dynamic situations, these cues may help protect the ankle ligaments if they can preactivate stabilizing musculature in anticipation of inversion stress at the ankle. The current study may have recreated a scenario that would not naturally occur during dynamic activity because the external cues were removed and the subjects stood at rest before the perturbation event. This may be another reason for a lack of any significant differences.

The study by Eils and Rosenbaum employed ankle-disk exercises, exercise bands, wooden inversion–eversion boards, and minitampolines, all of which are stationary activities. Because injuries to the lateral ankle structures rarely occur while standing at rest, the exact mechanism of an inversion ankle sprain is difficult to recreate in a laboratory setting. In other words, previous research has shown improved peroneus longus reaction time from a stationary trapdoor after using stationary exercises, whereas our research investigated peroneus longus reaction time with a stationary trapdoor after using dynamic exercises. In the current study, by standardizing our testing methods to previous studies using a stationary trapdoor device, we wanted to determine whether a multidirectional plyometric training program designed to stress the ankle dynamically would have the same effect on peroneal latency in a population with no reported symptoms of a lateral ankle sprain.
It is possible that plyometric training created secondary adaptations in other structures in the lower leg. Instead of showing a peroneal reflexive muscle adaptation, training may have resulted in increased ankle-joint stiffness and stability after sudden inversion caused by a cocontraction at the ankle. This would lengthen the time from inversion stress until lateral ligament injury, providing more time for the body to compensate for unexpected inversion through an enhanced muscle-recruitment pattern or by moving the center of gravity in anticipation of a fall. Plyometric training may also have more effect on the stability of the knee, rather than at the ankle, as previous literature suggests. Further research may be necessary to investigate the correlation between plyometric training and muscle adaptation of the lower extremity.

Limitations

Despite weekly physical activity requirements to participate, physical abilities differed greatly among the participants. Modifications to the plyometric protocol were implemented in 9 of the 24 training subjects, because they could not complete the activities in the protocol. Most could not flex the hip high enough to clear the hurdles or jump on the larger plyometric box. This could be caused by many factors including hip-flexor weakness or hamstring contractures. Modifying this exercise by lowering the hurdle and the plyometric box to a level suited to their hip flexibility permitted them to achieve success in the training. For 6 subjects, the hurdles were replaced with forward jumps, emphasizing increased hip flexion, and “touch-and-go” cues were added to make them move their feet as fast as they could and recoil as quickly as possible for the next jump. Because of the variability in our subjects’ athletic ability, more demanding inclusion criteria based on physical ability may be required in future studies to standardize the training.

Finally, prior investigations have shown that a 4- to 10-week training protocol produces adaptations of lower limb musculature, not changes in peroneal latency. A protocol longer than 6 weeks, that is more strenuous, or that includes more sessions per week than the one used in the current study may be needed to show significant changes in peroneal reaction time. If subjects had performed a longer, more strenuous program that focused on recreating the reflex activation at the ankle, we may have seen a change in the latency of the peroneal musculature.

Areas of Future Research

Plantar flexion plays a large role in detection of foot angle during inversion stresses at the ankle. Eils and Rosenbaum investigated the role of plantar flexion as a component of supination and showed that plantar flexing while inverting can help a subject sense a possibly damaging inversion moment. The platform used in our study held the foot at a flat, 0° position, disregarding plantar flexion, therefore limiting the tibialis anterior recruitment. Our trapdoor device may not have shown the muscle adaptations created because of its lack of plantar-flexion motion. Latency changes may have been shown with a trapdoor that incorporated some degree of plantar flexion associated with the drop. Future research may be needed to investigate the role that plantar flexion has in peroneus longus latency measurements and to determine whether muscle adaptations occur when the training regimen includes exercises that recruit ankle dorsiflexors and evertors.
Under the right circumstances, plyometric training may still result in adaptations to the protective reflex mechanism during a sudden inversion stress, but optimal parameters for a plyometric training program need to be established to show these changes in muscle adaptation because there are conflicting results for adaptation in the reaction time of the peroneus longus. It is possible that a training program of 8 to 10 weeks or longer may be required to develop muscle adaptations to inversion stress. Simply increasing the training protocol from 15 minutes per session to 30 minutes could also affect peroneus longus muscle activation. In addition, increasing the number of training sessions per week from 3 sessions to alternate days may enhance muscle adaptation.

Because differences are shown between the static response to injury and a dynamic response at the ankle, recreating an inversion moment during motion (walking or running) may reveal changes in latency values after a plyometric training program because the training is dynamic. Further research should look at the effect of plyometric training on the ankle musculature, tested by a dynamic-motion trapdoor that inverts while the subject is in motion.

Finally, muscle adaptation has been shown in subjects with acute symptoms when training is used for a rehabilitation program. Future research should look at changes in peroneus longus latency values in subjects with chronic or functional ankle instability to show a muscle adaptation in subjects in a neuromuscular deficiency.

**Conclusion**

A 6-week plyometric training protocol did not affect peroneus longus reaction time in a population without symptoms of acute ankle sprain. Further research may be needed to investigate the effects of a longer plyometric training program or using a population with chronic or functional ankle instability.

**Acknowledgments**

We would like to thank Koichi Katana, who assisted with data reduction and processing using MatLab software.

**References**


