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WEEKLY ANKLE LUNGE TEST SCREENING MIGHT HELP PREVENT ANKLE INJURIES

Mati Arend, Maarja Kalev, Martin Mooses, Jarek Mäestu

Institute of Sport Sciences and Physiotherapy, University of Tartu, Tartu, Estonia

ABSTRACT

Previous studies have indicated that almost 80% of injuries in track and field athletes affect the lower limb which makes injury prevention in this area so important. Therefore, it is important to constantly monitor the condition of athletes' musculoskeletal system during pre-season to prevent injuries and to maximize performance. To screen athletes, we performed an ankle lunge test along with injury registration during 15 weeks of the autumn training period. The tests were carried out on twelve semi-professional track and field athletes (seven male and five female) from one training group.

Nine of the twelve athletes suffered an injury to their lower extremity during the study period and five of them sustained an ankle or foot area injury. Changes in ankle dorsiflexion compared to the pre-study and on a week prior to the injury were indicators for ankle or foot area injury, especially when the measurement was outside standard deviations.

In conclusion, weekly screening by ankle lunge test and comparing the test results to the standard deviation of the previous average values may predict which athletes have an increased risk of ankle overuse injuries.

Keywords: *overuse; lower extremity; monitoring*

INTRODUCTION

It is believed that injuries are an integral part of sport, especially at the elite and professional levels. Track and field is very popular sport around the world, and, therefore, injuries have a potential to affect many athletes. Researchers [3, 6, 11] have shown that up to 76% of all injuries in track and field are overuse injuries, which most often involve lower extremities (64–87%). Similarly, Jacobsson

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et al. [12] have indicated that over two thirds of the Swedish track and field athletes have endured a performance-limiting overuse injury, most often in the knee or calf area (15.0% and 11.7%, respectively). Therefore, injury preventive screening and training of the lower extremities is particularly important for track and field athletes.

One of the proposed injury risk factors in the lower extremity is the change in ankle dorsiflexion (DF) range of movement. Decreased ankle DF range of movement might cause overuse in other parts of the kinetic chain in the lower limb affecting walking, running, jumping, squatting and other functional movements that are basic requirements for most track and field disciplines. Previous research of cricket and soccer players has shown that changes in ankle DF range of movement may predict a future injury [5, 7]. In order to screen for athletes at higher risk for lower extremity injuries due to changes in ankle DF, weight-bearing *ankle lunge test* has been used – measured as a distance from the big toe to the wall. Weight-bearing ankle lunge test measurements have demonstrated greater reliability and are more functional than non-weight-bearing tests [1, 3, 9, 16].

Therefore, we hypothesized from previous research that weekly screening by the ankle lunge test and the weekly data comparison to the average standard deviation may be used as an indicator for higher risk of injury, and it might help athletes and medical practitioners in preventing lower limb injuries.

METHODS

Study design and subjects

Seven male and five female national level track and field athletes volunteered to participate in the study during the 15 weeks of their autumn training period. Before the beginning the study, the athletes were interviewed for possible use of medications and for recent injuries during the previous two months. The subjects could not participate if they had had an injury or surgery to the lower limb during the previous two months, had felt pain in the lower limb or were taking pain medications. After explaining the study procedures, all eligible subjects signed a written informed consent. The subjects (Table 1) belonged to one training group and trained regularly 5–7 days per week under the same coach. The subjects' training experience indicates the time they have taken part in track and field training. All the subjects were members of the Estonian national track and field team. The current study was approved by the Ethics

Committee of the University of Tartu (N° 231/T-8). All testing was conducted at the University of Tartu Academic Sports Club.

Table 1. Subjects' anthropometric characteristics (mean ± SD).

	n	**Age** (years)	**Height** (cm)	**Weight** (kg)	**Training experience** (years)	**BMI** (kg/m^2)
Males	7	21.4 ± 1.0	184.4 ± 5.5	79.7 ± 6.2	6.9 ± 3.2	23.5 ± 2.3
Females	5	22.2 ± 1.3	171.6 ± 10.7	60.2 ± 6.3	8.6 ± 3.3	20.5 ± 1.6

Procedures

Ankle lunge test

Ankle lunge test was performed weekly on Mondays following the athletes' rest day in approximately the same period of the day (within 1–2h). Weight-bearing ankle lunge test [10] was performed against the wall and without footwear; the subjects looked forward at all times. No warm-up preceded the ankle lunge test. The subject's heel and great toe were aligned directly over a strip of tape measure perpendicular to the wall. The measurement started with the tip of the great toe placed against the wall. The subjects were permitted to place their hands on the wall in front of them, and they were standing in a tandem stance. With a lunge movement, the subject had to touch his or her knee to the wall. The distance from the great toe to the wall was increased by 1 cm until the subject could not maintain the heel contact with the floor. Heel contact was manually checked. The distance from the furthest point of the great toe to the wall was measured to the nearest 0.1 cm on a tape measure. Previous research on weight-bearing ankle lunge test has indicated that every 1 cm away from the wall is approximately 3.6° of ankle dorsiflexion [3].

One physiotherapist conducted all the measurements and registered the injuries sustained during the study period consulting a local sports physician to finalize the diagnoses.

Outcome measure

The main interest in our study was the cumulative incidence of musculoskeletal injuries to the lower extremities – ankle or foot area – during the 15-week study period.

Data analysis

Microsoft Excel and SPSS 22.0 (IBM Corp., USA) were used to analyse the data collected during the study period. Mean values and standard deviations were calculated (X ± SD) together with Cohen's D for effect size, and paired samples T-test was used to compare the results. Subjects' test results were compared to their own individual weekly test values, to average values and to SD. Statistical relevance was set at $p < 0.05$.

RESULTS

Weekly testing by the ankle lunge test was carried out for 15 weeks. From the 12 subjects who started the study, five athletes suffered a time-loss injury, and seven athletes could participate in all the 15 test weeks. Five subjects suffered an injury to their ankle or foot area during their training and could not continue training, and their measurement stopped at that time point. One athlete dropped out of the study for personal reasons on week 12.

Table 2 represents the average ankle lunge test values in the five athletes who sustained an ankle, foot or calf injury. In one case it was a traumatic ankle injury, but four were classified as overuse injuries.

Table 2. Average values (± SD) for ankle lunge test in five subjects who sustained an injury to the ankle area during the 15-week screening period. *p < 0.05

Athlete #	Ankle lunge test (cm)		*p*	Cohen's D effect size	Type of injury	Injury time (weeks)	Test change from baseline
	left	right					
1	6.8±0.4	11.8±1.1	0.000*	6.7	Traumatic lateral ankle sprain of the right leg	5	Lunge test ↑
2	8.6±0.8	7.0±1.4	0.062	1.5	Overuse type pain syndrome around right lateral malleoli	6	Lunge test ↓
3	14.9±1.1	14.0±1.2	0.004*	0.8	Right ankle overuse injury from CAI	10	Lunge test ↑
4	11.7±1.5	10.7±0.9	0.000*	0.8	Right Achilles midportion tendinopathy	8	Lunge test ↑
5	9.2±0.7	11.8±0.6	0.000*	4	compartment syndrome of the left calf (VAS 5)	11	Lunge test ↓

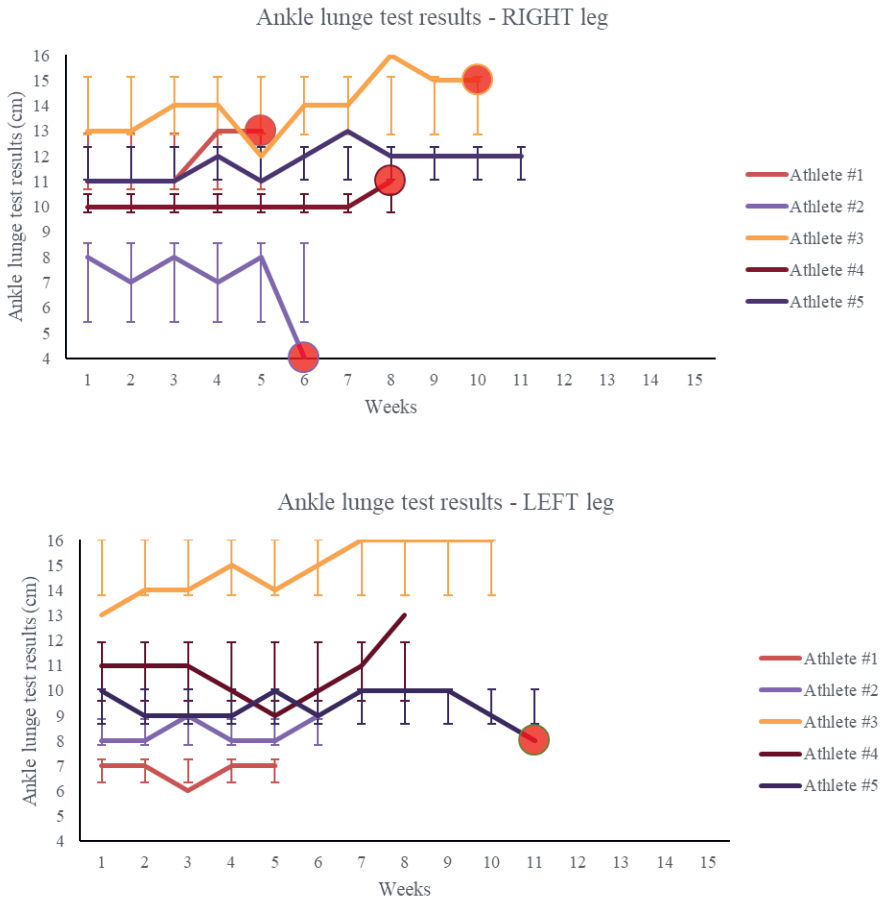

Figure 1 (A and B). The figures represent the results of the weekly ankle lunge test in the left (panel **A**) and the right (panel **B**) leg (± SD of average test values) in the subjects who sustained an injury to the ankle, calf or foot area. The red circle marks the last measurement before injury.

DISCUSSION

The aim of this study was to prospectively measure the efficacy of weekly ankle lunge test screening on track and field athletes' risks of overuse injuries in the lower limb.

When observing Germany's elite track and field athletes over the period of 14 years, Graff and Birken [8] have reported that the most prevalent injury was to the foot (33%) followed by the knee (17.6%) and the thigh (13.7%). Similarly, Alonso et al. [2] have reported that approximately 80% of the injuries during the 2009 IAAF World Athletics Championships involved the lower extremity. Also, in injury surveillance conducted at the World Athletics Championships in Daegu 2011, the majority of injuries were caused by overuse, and the most common injuries were thigh strain (14–17%) and especially hamstring strain (16%) followed by ankle sprain (3–6%) [2]. This is very similar to our findings in track and field athletes where five athletes out of twelve (42% of the cohort) suffered an injury to the ankle area, which consisted in a traumatic ankle inversion trauma, Achilles midportion tendinopathy, overuse injuries from Chronic Ankle Instability (CAI) and compartment syndrome. This suggests that regular musculoskeletal screening may provide important insight in track and field athletes to their coaches and medical personnel in preventing overuse injuries.

Previous research in cricket and soccer players has shown that changes in ankle DF range of movement may predict a future injury [5, 7], and a simple ankle lunge test is reliable to be used in the field to regularly screen the athletes. Less than 9 cm in ankle lunge test has been considered as restricted ankle DF [3, 1, 9], and the results over 15 cm have been considered as hypermobility [4]. Vicenzino et al. [18] have correlated decreases in ankle DF as a result of ankle ligament injuries. Also, Pope et al. [16] have proposed that decreases in ankle DF range of movement are related to 2.5 times higher likelihood, and the increases in ankle DF range of movement are related to 8 times higher likelihood of subsequent injury compared to norm values. In a systematic review, Powden et al. [17] concluded that 1.9 cm of ankle lunge test indicated the minimal detectable change in ankle DF range of movement needed to be outside the error of the measurement. In our five subjects who sustained ankle, foot or calf injury, the ankle lunge test measurement prior to the injury showed higher differences from baseline than 2 cm. This supports the usage of weekly ankle lunge test for screening athletes.

Out of the five participants in our study who sustained an injury to the ankle area, decreased ankle DF was present in two athletes and hypermobility was present in one subject. Figure 1 shows the individual results of ankle lunge test

during the 12-week period. Athlete #2 developed right Achilles midportion tendinopathy, and the range of movement in the ankle lunge test fluctuated from the start of the study but then decreased when the injury was reported. Also, on the week prior to the injury, the results in the right leg ankle lunge test decreased by 4 cm compared to the results in the same leg with the measurement outside the standard deviation. The non-involved left leg result was also outside the SD measurement and the ankle DF range of movement increased; so there was a side-to-side difference in the results. Athlete #3 sustained an ankle overuse injury and could not participate in the trainings after the tenth week due to CAI, which is being considered as the biggest risk factor for the future injury [14]. The average values of the ankle lunge test were higher compared to other athletes – 14.9 ± 1.1 cm in the left and 14.0 ± 1.2 cm in the right leg. In the case of athlete #3, there was a statistically significant ($p = 0.004$) difference in the average measurements between the right and the left leg showing decreased range of movement in the injured right leg. Interestingly, the ankle lunge test results indicated that the DF range of movement increased compared to pre-study measurements. At the point of injury, the measured movement in the right leg was 2 cm higher compared to pre-study measurement. Also, in the case of athlete #4, it can be seen on Figure 2 that on the fifth week there was a sudden decrease of 2 cm in the ankle lunge test measurement in the right leg compared to the results on the previous week, and the results were outside the standard deviation on week five and week eight. So, the fifth week results in the right leg were 5 cm lower than on the point of injury on the 10th week, which might indicate an overuse type of problem. Similarly, Mahieu et al. [13] have also shown that increases in ankle DF range of movement are an indicator for Achilles tendon overuse injuries.

Side-to-side differences in ankle lunge test results are also considered a risk factor for lower limb injuries [16]. In our study group, four subjects had statistically significant side-to-side differences in ankle lunge test measurements between the right and the left leg. Athlete #1 suffered a traumatic ankle inversion injury on the fifth week and showed statistically significant differences ($p = 0.000$) between the average measurements. A 6 cm side-to-side difference in the ankle lunge test measurement was evident a week before the injury, and the results were outside the standard deviation. Athlete #5 developed left calf *compartment syndrome* and weekly ankle lunge test screening showed a statistically significant ($p = 0.000$) decrease in the range of movement in the left compared to the right leg (9.2 ± 0.7 vs 11.8 ± 0.6, respectively), and the difference was greater than the minimal detectable change [17]. Also, on the

week prior to the injury, ankle lunge test results on the left leg were outside the standard deviation measurement.

CONCLUSION

Our findings confirm that ankle area overuse injuries are quite common in highly trained track and field athletes, and a simple ankle lunge test might be used on a weekly basis to compare the weekly test results to the athlete's own baseline or previous week's results to the standard deviation to screen for athletes who might need individual assessment or therapy to prevent an injury.

LIMITATIONS

Blinding of subjects to all results and the raters to previous measurements should have been taken into consideration to reduce the potential for bias. Also, altering foot position every time may result in greater variation of the results, and for future studies a technique proposed by O'Shea and Grafton [15] might be considered where subjects push the table with the knee and the foot remains stationary.

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Address for correspondence:
Mati Arend
Institute of Sport Sciences and Physiotherapy, University of Tartu
Ujula 4, Tartu 51014, Estonia
E-mail: mati.arend@ut.ee