# The Effect of Ankle Dorsiflexion Range of Motion on Lower Extremity Injuries

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## Abstract

**Context:** The weight-bearing lunge test is an effective method in determining the range of motion of ankle dorsiflexion. Despite the lack of research for this test it does have good inter-rater and intra-rater reliability. Therefore, the purpose of this study is to identify baseline data for athletes and observe the relationship between ankle dorsiflexion measurements and non-contact lower extremity injuries. Ankle dorsiflexion can be defined as the degree as to which the dorsal portion of the foot can be brought closer to the tibia. A lack of ankle dorsiflexion can cause varied biomechanics and loading patterns which can lead to overcompensation resulting in possible injury. **Objective:** The purpose of this study is to determine the effect of ankle dorsiflexion range of motion on the presence of non-contact lower extremity injuries. We hypothesized that those who have a decreased ankle dorsiflexion ROM are at a greater risk of experiencing a non-contact lower extremity injury. **Design:** Prospective Cohort Study. **Setting:** Athletic Training Clinic at a mid-west NAIA institution. **Patients or Other Participants:** We tested a total of 315 athletes, college-aged students (122 females and 194 males; aged range = 17-23). **Methods:** Prior to the competitive sports season (fall 2019) ankle dorsiflexion ROM was recorded using the weight-bearing lunge test on 315 healthy college athletes. Participants measured for this study participated in football (n=117), men's soccer (n=31), women's soccer (n=28), women's volleyball (n=26), co-ed cross country (n=36), co-ed cheerleading (n=20), dance team (n=7), women's basketball (n=21), and wrestling (n=26). The Clinometer smart phone app was used to measure ankle dorsiflexion during the test. The smartphone was placed at 5 cm below the tibial tuberosity as the participant performed the lunge. Participants performed the weight-bearing lunge test three times on each leg and the average angle of the three trials was used for the data analysis. Athletes who had experienced a lower extremity injury in the previous six months were excluded from the study. The weight-bearing lunge test has been shown to have good intra-rater reliability (ICC =.712-.973; p=.036-<.001) and inter-rater reliability (ICC=.987; p<.001). **Main Outcome Measures:** Ankle dorsiflexion range of motion using the weight-bearing lunge test and non-contact lower extremity injuries. **Results:** Results were calculated using T-Tests using IBM SPSS software. There was a total of 38 injured and 237 uninjured athletes. There was no statistically significant (p = .656 ) in average ankle dorsiflexion between participants that were recorded as injured (42.30°) vs. Uninjured (46.69°). The correlation for asymmetry between the ankle dorsiflexion range of motion on the right leg vs. left leg between the injured (3.12°) vs. uninjured (9.48°) participants was also not statistically significant (p = .497) **Conclusion:** This study uses the weight-bearing lunge test to measure ankle dorsiflexion in the collegiate athletic population to find normative data. This normative data was used to determine if restricted ankle dorsiflexion caused an increased risk of lower extremity injuries. Our data showed no significant correlation between restricted ankle dorsiflexion and risk of injury to the lower extremities. There was also a lack of significance comparing asymmetry between the left and right leg in both injured and uninjured groups. Further research is needed to determine if restricted ankle dorsiflexion, measured with the weight-bearing lunge test, does or does not cause an increased risk of lower extremity injuries in the athletic population.

## Introduction

Research suggests that limited ankle dorsiflexion can predispose athletes to lower extremity injuries.[1,2,3] Normative data for non-weight-bearing dorsiflexion has been determined, but there has been limited research completed to determine normative ROM values for weight-bearing dorsiflexion. The weight-bearing lunge test (WBLT) is a simple way to measure ankle dorsiflexion that has a high inter-rater and intra-rate reliability.[4,5] There is limited data on normative values for the WBLT. Limited dorsiflexion ROM could be a determining factor in the risk assessment for lower extremity injuries in athletic populations. Research shows the sagittal-plane coupling of the lower extremity joints and their importance in landing biomechanics and ground reaction forces.[1] While there is independent importance of ankle dorsiflexion range of motion, it is also interrelated to the function of the hip and knee.[1,3] Koga et. al. showed an increase in reaction forces caused by the ground causing greater knee valgus displacement. This study also showed that restricted ankle dorsiflexion can exacerbate the effect these forces have on the knees.[2] Decreased ankle dorsiflexion has effects at proximal joints while also contributing to altered landing biomechanics both in the sagittal and frontal plane as well as greater knee and hip displacement.[2,3] The purpose of this study was to determine if there is correlation between lower extremity non-contact injuries and limited ankle dorsiflexion range of motion.

## Methods

**Study Design**

A cross-sectional study design was used to compare preseason ankle dorsiflexion range of motion with noncontact lower extremity injuries. Only noncontact lower extremity injuries were considered and were recorded using the ATS system.

**Participants**

Three-hundred and fifteen college athletes (194 males and 122 females; age range = 1.288 ± 1.135) participated in this study. All participants were fall or winter sport athletes from football (117), men's soccer (31), women's soccer (28), women's volleyball (26), co-ed cross country (36), co-ed cheerleading (20), dance team (7), women's basketball (21), and wrestling (26).

**Instruments**

Ankle dorsiflexion was measuring using the Clinometer App

**Procedures**

Participants were measured before starting mandatory practice with the team. Each participant was marked 5 cm distal to the tibial tuberosity on both legs to identify location of the smartphone. When measuring dorsiflexion using the WBLT, the leg being measured was staggered in front of the other leg. As the participant began to lunge forward tracking the measured knee directly over the measured foot, the measurement was taken just prior to the when the heel of the measured foot was lifted off of the ground or until the participant could not bend any further. This process was repeated three times on each leg and the average measurement was used for data analysis.

Table 1

| Sport | Average | Asymmetry |
|---|---|---|
| MSC | 41.04 | 2.71 |
| WSC | 42.64 | 3.48 |
| FB | 41.31 | 2.9 |
| Dance | 43.37 | 8.11 |
| Cheer | 41.53 | 2.13 |
| XC | 45.47 | 2.65 |
| WR | 47.31 | 2.36 |
| WBB | 43.63 | 2.04 |
| VB | 44.63 | 2.77 |

Figure 1

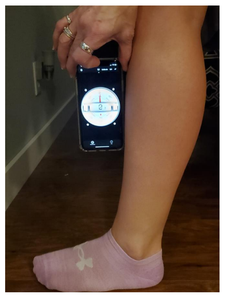

Figure 2

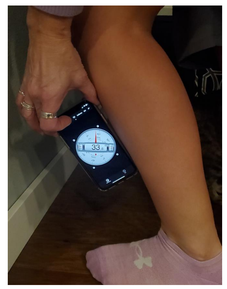

Table 2

| Values | Status | Number | Mean | Standard Deviation |
|---|---|---|---|---|
| Average | Injured | 38 | 46.67 | 5.34 |
| | Not Injured | 239 | 42.46 | 4.9 |
| Asymmetry | Injured | 38 | 3.17 | 1.93 |
| | Not Injured | 239 | 9.39 | 6.77 |
| Average L | Injured | 38 | 41.93 | 5.44 |
| | Not Injured | 239 | 43.03 | 5.09 |
| Average R | Injured | 38 | 42.99 | 5.86 |
| | Not Injured | 239 | 43.48 | 5.16 |

**Table 1**- average dorsiflexion and asymmetry by sport
**Table 2**- average dorsiflexion and asymmetry for all injured and uninjured participants; including leg specific measurements
**Figure 1**- starting position with clinometer placement
**Figure 2**- subject in final position

## Results

There was no statistically significant (p = .656 ) in average ankle dorsiflexion between participants that were recorded as injured (42.30°) vs. Uninjured (46.69°). The correlation for asymmetry between the ankle dorsiflexion range of motion on the right leg vs. left leg between the injured (3.12°) vs. uninjured (9.48°) participants was also not statistically significant (p = .497)

## Discussion

The results of this study do not indicate a correlation between preseason ankle dorsiflexion range of motion measured using the WBLT and noncontact lower extremity injuries sustained over the course of a competitive season. This is not consistent with current research which has shown a correlation between decreased ankle dorsiflexion and altered biomechanics which leads to an increased risk for lower extremity non-contact injuries.[1,2,3] The lack of correlation between lower extremity injuries and ankle dorsiflexion ROM may be due to measuring weight-bearing ankle dorsiflexion instead of non-weight-bearing ankle dorsiflexion. We also included athletes from any year in college (freshman to senior) with the understanding that older students incorporate ankle dorsiflexion ROM exercises into their strength and conditioning programs. Therefore, returning athletes could already have an increased ankle dorsiflexion range of motion causing them to be less susceptible to non-contact injuries as a result of altered biomechanics. Further research should focus on expanding the number of participants and should look at other joints such as the hip and knee.

## Conclusions

This study uses the weight-bearing lunge test to measure ankle dorsiflexion in the collegiate athletic population to find normative data. This normative data was used to determine if restricted ankle dorsiflexion caused an increased risk of lower extremity injuries. Our data showed no significant correlation between restricted ankle dorsiflexion and risk of injury to the lower extremities. There was also a lack of significance comparing asymmetry between the left and right leg in both injured and uninjured groups. Further research is needed to determine if restricted ankle dorsiflexion, measured with the weight-bearing lunge test, does or does not cause an increased risk of lower extremity injuries in the athletic population.

## Sources

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