Relationships Between Measures of Posterior Talar Glide and Ankle Dorsiflexion Range of Motion

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ABSTRACT

Restrictions in posterior talar glide may lead to decreases in dorsiflexion range of motion (ROM). Restricted posterior talar glide and dorsiflexion ROM have been described in the literature, but little is known about the relationships between them. The purpose of this study was to examine the relationship between 4 dorsiflexion ROM measurements and talar glide as measured manually by the posterior talar glide test (PTGT) and posterior talar displacement as measured by an arthrometer. Forty-seven participants were enrolled in the study. Measures included posterior talar glide assessed manually, posterior talar displacement assessed with an arthrometer, and dorsiflexion ROM in 4 different positions. Relationships between measures ranged from weak to moderate, with the strongest relationship occurring between dorsiflexion ROM in the standing position and the PTGT. Techniques that maximize total available ROM and clinical assessment tools that can detect arthrokinematic restrictions could be valuable for clinicians.

Dorsiflexion range of motion (ROM) is a common lingering impairment following lateral ankle sprains. Decreases in dorsiflexion ROM may increase an individual’s susceptibility to re-injury and have an impact on both running and walking gait patterns. Although ankle dorsiflexion ROM may be grossly restored following lateral ankle sprains, capsular limitations may still be present. Changes in muscle firing patterns and altered joint arthrokinematics can ultimately impact gait and are thought to be associated with increased risk of ankle osteoarthritis. Although rehabilitative management of ankle sprains can reduce persistent issues and long-term consequences, further strategies should be explored to decrease this sequela of events.

Dorsiflexion ROM measurements attempt to measure the available degrees of motion in the ankle. Measurements can be obtained from the patient in a seated or standing position with the knee extended or slightly flexed. Arthrokinematics of the talocrural joint are dependent on the position of the patient during the measurement. In an open kinetic chain (OKC), such as seated with the knee straight, during dorsiflexion, the talus glides in a posterior-medial direction on the tibia. However, in a closed kinetic chain (CKC) the tibia is moving on the talus while the talus is in a fixed position; for dorsiflexion to occur in the CKC, the tibia is not only gliding anteriorly, but is also rotating internally. Although both measurement techniques measure the same motion at the ankle, they achieve it through the use of different arthrokinematics.

The posterior talar glide test (PTGT) is a clinical measure of talar glide that has been described in the literature to assess posterior limitations of the talocrural joint. The PTGT allows clinicians to assess the arthrokinematic motion of the talocrural joint in patients experiencing ankle pathology. The PTGT is performed as the clinician glides the patient’s talus posteriorly in the OKC. This maneuver simultaneously results in passive ankle dorsiflexion and passive knee flexion. The total amount of knee flexion is measured as a surrogate for the amount of posterior talar glide, as these 2 measures are proportional to each other.
Further passive knee flexion cannot occur if the ankle is at the end of its dorsiflexion ROM because the talus cannot move posteriorly. Therefore, the angle of passive knee flexion provides an estimate of posterior talar glide. The PTGT has been used in the research literature to assess arthrokinematics of the talocrural joint in patients experiencing recurrent ankle sprains. The PTGT is a reliable clinical assessment tool, but it relies largely on the clinician’s subjective assessment of the end-feel of posterior talar translation. Due to the subjectivity of this test, it may not be the optimal test for research purposes.

Objectively, the instrumented ankle arthrometer has been used to assess laxity and posterior talar displacement and stiffness in individuals with a wide range of foot and ankle pathologies. It allows researchers and clinicians to determine mobility and laxity at the talocrural and subtalar joint. The ankle arthrometer has been proven to demonstrate high validity and reliability. Together, the ankle arthrometer and the PTGT are capable of assessing arthrokinematic restrictions at the talocrural joint. A strong relationship between the ankle arthrometer and the PTGT measures would allow clinicians to quantify talocrural restrictions.

Limited dorsiflexion ROM has been associated with a lack of posterior talar glide on the tibia in patients with ankle sprain. At least 10° of dorsiflexion ROM is needed for proper gait biomechanics. In order to achieve full dorsiflexion ROM, several factors must be present: (1) adequate talar glide, (2) adequate flexibility of the triceps surae, and (3) anatomical alignment of the tibia, fibula, and talus. Decreased flexibility of the triceps surae has been associated with decreases in dorsiflexion ROM. In the supine straight leg position, it could be argued that dorsiflexion ROM is not only determined by the glide of the talus but also the flexibility of the triceps surae. Several studies using patients with chronic ankle instability and acute lateral ankle sprain have used dorsiflexion ROM as an outcome measure to assess the efficacy of a joint mobilization technique; however, there are inconsistencies in the measurements used and the position that dorsiflexion ROM was measured. Consistency in the measurement technique and a clinical tool that allows practitioners to assess restrictions at the talocrural joint are needed.

Therefore, the primary purpose of this study was to examine the relationships between the amount of talar glide measured with the PTGT and with the ankle arthrometer, and the 4 different positioning measurements of dorsiflexion: (1) seated straight knee, (2) prone bent knee, (3) standing straight knee, and (4) standing bent knee. A secondary purpose of this study was to examine the relationship between the PTGT and displacement as measured with the ankle arthrometer. We hypothesized that the amount of talar glide would be moderately correlated to all dorsiflexion ROM measures. In addition, we hypothesized that there would be a moderate relationship between the 2 measures of posterior talar glide and that the 4 dorsiflexion ROM measures would be moderately correlated with each other.

**METHODS**

**Design**

A descriptive laboratory study was performed to examine relationships between talar glide, displacement, and dorsiflexion ROM in healthy individuals. The main outcome measures were posterior talar displacement as assessed with an instrumented arthrometer, posterior talar glide as measured by the PTGT, and dorsiflexion ROM assessed in seated straight knee, prone bent knee, standing straight knee, and standing bent knee positions.

**Participants**

A total of 47 participants (20 males, 27 females), with an age range from 18 to 44 years (mean age for women 25.1 ± 5.4; mean age for men 25.2 ± 6.2) were included in the study. Participants qualified for the study if they were at least 18 years of age with no self-reported neurological pathology or lower extremity pain, and if they were not currently under the care of a medical professional for any lower extremity musculoskeletal complaint. Prior to entering the study, all participants were screened and filled out a lower extremity health history questionnaire. If participants met the inclusion criteria, they received a full explanation of the process. All participants signed informed consent, and the institutional review board of the university approved the study.

**Instrumentation**

We used a fluid-filled bubble inclinometer to measure dorsiflexion ROM and to obtain talar glide measurements. A hook and loop fastener was attached to the back of the inclinometer, and the strap was applied around the participant’s leg or foot during measurements. An instrumented ankle arthrometer (Hollis Ankle Arthrometer; Blue Bay Research, Inc., Milton, Fla) was used to measure displacement of the talus. The reliability of measures
of anterior-posterior displacement with the arthrometer has been previously reported.\textsuperscript{11,14}

**PROCEDURES**

Participants reported to the university athletic training clinic for testing. The participant’s dorsiflexion ROM, talar displacement, and talar glide were recorded. The order of dorsiflexion ROM, talar displacement, and talar glide measurements were counterbalanced using a Latin square design to avoid an order effect. Prior to testing, patients were instructed to remove their shoes and socks.

**Dorsiflexion ROM Measurements**

Dorsiflexion ROM measurements were taken in 4 different positions and were repeated 3 times, with the mean of the 3 trials to serve as the main outcome measure. The 4 positions measured were seated straight knee, prone bent knee, standing straight knee, and standing bent knee, as previously described by Denegar et al.\textsuperscript{2} The seated straight knee (Figure 1B) measurement was taken with the participant seated, the knee in terminal extension, and the inclinometer adhered to the base of the fifth metatarsal. The patient was instructed to actively dorsiflex the talocrural joint maximally. Once the patient was at their reported end range, the angle of dorsiflexion was recorded. The prone bent knee (Figure 1A) measurement was taken with the participant in a prone position with the knee flexed to 90°. For this position, the bubble inclinometer was adhered to the base of the fifth metatarsal with the bottom parallel to the floor, in the starting position. Once the patient was in the correct position, he or she was instructed to actively dorsiflex the talocrural joint while maintaining 90° of knee flexion. At the patient’s self-reported end range, the angle of dorsiflexion was recorded.

For both standing positions, the inclinometer was placed approximately 6 cm above the lateral malleolus. To obtain dorsiflexion ROM measurements for the standing positions, the bubble inclinometer was zeroed on a surface that was parallel to the table on which the patients would be standing. After the inclinometer was zeroed, the examiner applied the inclinometer above the lateral malleolus. For the standing straight knee (Figure 2B) position, the participant was instructed to start with the feet shoulder width apart. In this position, ankle dorsiflexion ROM was measured by having the participant maintain terminal knee extension while the contralateral limb was placed anteriorly to the test limb. To avoid excessive foot eversion, the examiner instructed the patient to keep all 5 digits in the anterior and sagittal plane. The participant was also instructed to keep the posterior leg in the knee extension while lunging forward with the anterior leg.

Maximum dorsiflexion ROM was considered to be the angle in which the participant was able to lunge forward without lifting the posterior calcaneus off of the examining table. Once maximum standing straight knee was obtained, the angle dorsiflexion ROM was recorded. The standing bent knee (Figure 2A) measurement was taken with the participant standing on the examining table. The participant was instructed to flex the posterior knee while using the anterior knee to balance. Once maximum dorsiflexion was achieved, the angle of dorsiflexion was recorded. The examiner instructing the participants was also the examiner who recorded the dorsiflexion ROM measurements. Measurements for each position were recorded in between each repetition.

**Posterior Talar Glide Test**

The PTGT measurement was taken with the bubble inclinometer fastened approximately 6 cm above the participant’s lateral malleolus. Passive knee flexion during dorsiflexion ROM, while the foot was placed...
Posterior Talar Glide and Ankle Dorsiflexion Range of Motion

in subtalar neutral, was used as an assessment of posterior talar glide.\textsuperscript{2,8} The participant was seated on the end of an adjustable examining table with his or her shank hanging off of the table. After positioning the inclinometer, the participant’s foot was placed into a subtalar neutral position and the examiner gently pushed the talus posteriorly, and the ankle into dorsiflexion, until a firm capsular end-feel was encountered.\textsuperscript{2} Once the examiner was at the endpoint, the glide was stopped and the angle of knee flexion was recorded. Measurements were repeated 3 times with the mean of the 3 repetitions serving as an outcome measure (Figure 3).

Talar Displacement
Measurement of talar displacement was conducted using a portable ankle arthrometer; data were collected and analyzed using a custom software program (LabVIEW; National Instruments Corp., Austin, Tex). The ankle arthrometer assesses translatory and uniplanar rotary displacement of the foot in relation to the leg.\textsuperscript{11} The arthrometer was connected to a computer that had an analog-to-digital converter, which allowed for displacement (mm) and force (N) values to be calculated simultaneously. Prior to testing talar displacement, both the participant’s foot and the arthrometer were sprayed with adhesive to avoid slippage of the foot during the posterior movement. During the arthrometer testing, the participant was placed in a supine position with a foam bolster underneath the knee of the test limb to standardize the knee flexion angle between all participants. With the ankle in a neutral position, an anterior-posterior force of 170 N was applied to the patient’s ankle (Figure 4). Posterior displacement of the talus was measured in mm. This method of quantifying posterior talar displacement has been previously reported.\textsuperscript{15} Three measurements were taken, with the mean serving as an outcome measure and the arthrometer was removed.

DATA ANALYSIS
For all analyses, data from the left and right limbs were analyzed separately. This decision was made in lieu of the alternatives of considering each limb as a subject (so called “double dipping”). Analyzing the data of the dominant or nondominant limb would require us to lose half of our data set, and averaging the measures of the left and right sides together does not allow us to directly compare the correlation between our selected measures on individual limbs.\textsuperscript{15} The intratester reliability for each of the 4 ranges of motion, talar glide, and displacement measures were estimated by calculating the intraclass correlation coefficients (ICC 3,1) and the accompanying standard error of measurement (SEM). The same examiner took repeated measurements to assess reliability on the same day.

To compute a correlation coefficient between variables, Pearson product moment correlation coefficients were calculated to determine whether relationships existed between the 4 different dorsiflexion ROM measurements, talar glide, and displacement measures. A correlation coefficient ($r$) of 0 to 0.4 was considered to represent a weak relationship, a coefficient of 0.4 to 0.7 was considered to represent a moderate relationship, and a coefficient of 0.7 to 1.0 was considered to represent a strong relationship.\textsuperscript{16} The level of significance was preset at 0.05 for the analysis. All statistical analysis was performed using SPSS version 16.0 statistical software (SPSS Inc., Chicago, Ill).
### RESULTS

**Range of Motion Measures**

Means, standard deviations, and 95% confidence intervals for all measures are presented in Table 1.

**Reliability**

Intratester reliability estimates of ROM measures ranged from 0.87 to 0.95; from 0.85-0.86 for talar glide measures; and 0.89-0.92 for displacement measures (Table 2).

**Correlations**

Tables 3 and 4 list the correlations between dorsiflexion ROM positions, talar glide, and displacement measures. Eleven significant correlations were identified.

Three significant relationships were observed between dorsiflexion ROM and talar glide, as measured manually by the PTGT. There was a moderate relationship between posterior talar glide and the standing straight knee position on the right side \( (r = 0.43, P = .002) \); on the left side there was a weak relationship between posterior talar glide and the standing bent knee position \( (r = 0.30, P = .04) \). The strongest relationship was on the left side between the standing straight knee position and posterior talar glide \( (r = 0.50, P = .001) \).

The only significant relationship between dorsiflexion ROM and posterior talar displacement, as measured by the ankle arthrometer was in the standing bent knee position \( (r = 0.31, P = .04) \).

There were 4 significant relationships between dorsiflexion ROM and posterior talar glide of the talus, as measured by the arthrometer and PTGT, and the coefficients associated with these relationships were not considered high.

Eight significant correlations were found between the 4 different dorsiflexion ROM positions. The strength of the correlations ranged from weak to moderate \( (r = 0.10 \text{ to } 0.69, \text{ respectively}) \). The strongest relationship was on the right side between the standing straight knee and standing bent knee positions \( (r = 0.69, P < .001) \).

### TABLE 1

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>RIGHT LIMB (95% CI)</th>
<th>LEFT LIMB (95% CI)</th>
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<tbody>
<tr>
<td>SSK</td>
<td>96±6.3 (90–12.6)</td>
<td>108±6.3 (78–11.3)</td>
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<tr>
<td>PBK</td>
<td>140±6.5 (130–16.7)</td>
<td>148±6.4 (121–15.8)</td>
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<tr>
<td>STBK</td>
<td>34±6.7 (32.7–37.5)</td>
<td>35±6.7 (36.7–32.9)</td>
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<tr>
<td>STSK</td>
<td>32±6.7 (35.4–31.6)</td>
<td>33.±6.7 (30.6–34.4)</td>
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<tr>
<td>Glide</td>
<td>26±7.0 (26.4–30.4)</td>
<td>25±7.0 (24.0–28.0)</td>
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<tr>
<td>Displacement</td>
<td>4.7±1.6 (4.25–5.2)</td>
<td>5.1±2.8 (4.35–6.00)</td>
</tr>
</tbody>
</table>

*Table 1: Means, Standard Deviations, and 95% Confidence Intervals (CI) of Dorsiflexion Range of Motion Measurements, Talar Glide, and Talar Displacement.*

### TABLE 2

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>ICC (95% CI)</th>
<th>SEM (95% CI)</th>
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<tr>
<td>SSK</td>
<td>0.95 (0.92-0.97)</td>
<td>1.41 (1.09-1.78)</td>
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<tr>
<td>PBK</td>
<td>0.92 (0.88-0.95)</td>
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<tr>
<td>STBK</td>
<td>0.88 (0.81-0.92)</td>
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<tr>
<td>STSK</td>
<td>0.91 (0.85-0.94)</td>
<td>2.01 (1.64-2.59)</td>
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<tr>
<td>Glide</td>
<td>0.86 (0.79-0.92)</td>
<td>2.62 (1.98-3.21)</td>
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<tr>
<td>Displacement</td>
<td>0.89 (0.83-0.94)</td>
<td>0.52 (0.40-0.67)</td>
</tr>
</tbody>
</table>

*Table 2: Reliability (ICC 3,1), Precision (SEM) Estimates, and 95% Confidence Intervals (CI) of Dorsiflexion Range of Motion Measurements, Talar Glide, and Talar Displacement.*
DISCUSSION

The purpose of this study was to examine the relationships between talar glide as measured by the PTGT, posterior displacement as measured by the ankle arthrometer, and 4 different dorsiflexion ROM measurements among healthy participants. When examining the relationship between the 4 dorsiflexion ROM measurements and talar glide as measured with the PTGT, the strongest relationship occurred with the standing straight knee measurement on the right and left sides. The relationship between posterior talar glide as measured with the ankle arthrometer and the 4 different dorsiflexion ROM was weak, with the strongest relationship occurring on the right side in the standing bent knee, sitting straight knee, and prone bent knee positions, respectively. We also identified several positive relationships between the 4 dorsiflexion ROM measurements with the strongest relationship occurring between the 2 standing dorsiflexion ROM positions on both sides.

Arthrokinematics of the talocrural joint during OKC involves the talus gliding posteriorly on the tibia; this accessory motion allows dorsiflexion ROM to occur. In healthy individuals, increases in talar glide should be associated with increases in dorsiflexion ROM. Our hypothesis, given the talocrural anatomy, was that dorsiflexion ROM and talar glide as measured with the PTGT and displacement as measured with the ankle arthrometer would be strongly correlated with each other. We found that measurements of dorsiflexion ROM, using

<table>
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<th>TABLE 3</th>
<th>Correlations Between Dorsiflexion Range of Motion Measures, Talar Glide, and Talar Displacement on the Right Side</th>
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<tbody>
<tr>
<td>MEASURE</td>
<td>PBK</td>
</tr>
<tr>
<td>PBK</td>
<td></td>
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<tr>
<td>Pearson r</td>
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<tr>
<td>Significance (2-tailed)</td>
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</tr>
<tr>
<td>SSK</td>
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<td>Significance (2-tailed)</td>
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</tr>
<tr>
<td>Significance (2-tailed)</td>
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</tr>
<tr>
<td>STBK</td>
<td></td>
</tr>
<tr>
<td>Pearson r</td>
<td>0.30*</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>0.04</td>
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<tr>
<td>Glide</td>
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</tr>
<tr>
<td>Pearson r</td>
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<tr>
<td>Significance (2-tailed)</td>
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<tr>
<td>Displacement</td>
<td></td>
</tr>
<tr>
<td>Pearson r</td>
<td>0.25</td>
</tr>
<tr>
<td>Significance (2-tailed)</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Abbreviations: PBK, prone bent knee; SSK, sitting straight knee; STSK, standing straight knee; STBK, standing bent knee; glide, manual posterior talar glide; displacement, posterior talar translation with arthrometer.

* (P < .05)
** (P < .01)
the PTGT, in the OKC were weakly associated with talar glide and in the CKC were moderately associated with the posterior glide of the talus. The higher association of the CKC measurement and talar glide may be explained by an increase in the torque being applied to the ankle in the CKC, compared with the OKC measurements. Increases in torque may be more indicative of the ROM that is available for functional tasks. Another explanation for the stronger relationship in the CKC may be that the weight bearing dorsiflexion ROM measurements provide the clinician with a cumulative measure of motion available at the talocrural, subtalar, and intertarsal joints. When measuring dorsiflexion ROM in the CKC as opposed to OKC, the number of joints contributing to dorsiflexion ROM may be increased.

Weak relationships were observed between the 4 dorsiflexion ROM measurements and talar displacement, as assessed with the ankle arthrometer. One significant relationship ($r = 0.31, P = .04$), was noted between the standing bent knee position and the talar displacement measure on the right side. This significant finding suggests that in the standing bent knee position, the ankle complex may not have been affected by the noncontractile components of the gastrocnemius. A decrease in the involvement of the gastrocnemius could have led to an increase in standing bent knee dorsiflexion ROM. The weakest relationship between talar displacement and dorsiflexion ROM was observed in the standing straight knee position. Although the standing bent knee and the standing straight knee position had weak relationships with the displace-
ment measures ($r = 0.04$ to $0.07$, $r = 0.27$ to $0.31$, respectively), the standing bent knee measurement was more strongly related to displacement when measured with the ankle arthrometer. Differences between the standing measures and their relationship with talar displacement may be linked to the removal of the contribution of the gastrocnemius during the standing bent knee measurement. Although we acknowledge that the relationships between talar glide and dorsiflexion ROM were weak to moderate, the lack of strong relationships between talar glide as measured with the instrumented arthrometer and the PTGT may be a result of restrictions within the contractile tissues and not necessarily a true restriction in posterior talar glide. Pathological restrictions in posterior talar glide would not be expected in this group of participants because they were healthy individuals. Therefore, any restriction in dorsiflexion ROM may be attributed to the contractile components of the lower extremity, specifically the triceps surae muscle group.

We hypothesized that measures of talar glide and displacement would be moderately correlated with each other. However, relationships between talar glide as measured with the PTGT and talar displacement were weak ($r = -0.04$ to $0.13$). Differences in the number of relationships observed between the 2 measures of talar glide and dorsiflexion ROM may be attributed to the nature of the instruments being used to capture talocrural arthrokinematics. We believe that stronger relationships were not observed when this instrumented ankle arthrometer was used because a force of 170 N may not have been enough to reach a firm capsular end-feel, which may have limited our ability to determine the maximum posterior displacement of the talus in these healthy individuals. A magnitude of 170 N of force has been used in previous research to capture the amount of posterior talar displacement in lower extremity injured patients immediately after removal of an immobilization device.

However, because the individuals in the current study were healthy, capturing maximum posterior displacement may have required a greater amount of force for ankle arthrometer measurements. During measurements with the ankle arthrometer, the calcaneus is secured to the footplate, and motion of the calcaneus is measured with respect to the fixed tibia. Therefore, the measurement of posterior displacement is a reflection of motion at the subtalar and talocrural joints. In addition, the PTGT relies on the clinician’s interpretation of capsular end-feel. During the PTGT, the maximum knee flexion angle is used as surrogate measure for the amount of posterior talar glide, providing the clinician with an estimate of posterior talar glide. Thus, both measures of talar glide provide proxy estimates for the amount of talar glide in the posterior direction.

In the OKC positions, we found a weak correlation between the prone bent knee position and the sitting straight knee ROM measurements. The weak relationship between the 2 measurements could indicate that the 2 measurements may not be capturing the same osteokinematic motion occurring at the talocrural joint. It is possible that in the OKC, dorsiflexion ROM may have been limited to inflexibility of the gastrocnemius and soleus complex, as opposed to an arthrokinematic restriction. The weak relationship between the 2 OKC measurements may also be attributed to the use of active ROM measurements, as opposed to passive ROM measurements for our outcome measures. Using passive ROM may have overcome any muscular restraints associated with the gastrocnemius-soleus complex, which could have led to a stronger relationship between the 2 OKC measurements.

In the CKC, measurements of dorsiflexion ROM were moderately correlated; indicating that the 2 standing measurements were capturing the same osteokinematic motions at the talocrural joint. Weight bearing measurements allow the clinician to objectively capture the amount of functional ROM available at the talocrural joint. Dorsiflexion ROM in the weight bearing position has also been measured using a standing weight bearing lunge technique. The moderate relationship and the high reliability results presented in this study provide support for the use of a weight bearing dorsiflexion ROM measurement as an objective measurement tool in clinical practice. Measurements in the CKC may be a better indicator of the dorsiflexion ROM that is available for functional tasks. Although CKC measurements provide clinicians with a more functional approach to measuring dorsiflexion ROM, caution should be taken when individuals have an acute injury and dorsiflexion is limited by pain or swelling.

The reliability results for the 4 dorsiflexion ROM measurements, PTGT, and arthrometer measures were high, with an associated small standard error of measurement. These results suggest that the same clinician could consistently perform the techniques used to measure dorsiflexion ROM and to quantify posterior glide in healthy participants. The reliability results for dorsiflexion ROM as measured in the 4 positions and the assessment tools
used to quantify posterior talar glide are similar to those reported by Denegar et al.\textsuperscript{2,8} Intra-class correlation coefficients were calculated with the 3,1 formula in this study. Although the use of this type of ICC allows for the results to be more generalized, it does not include the total mean square value and therefore may artificially inflate the magnitude of the correlation coefficient.

LIMITATIONS

Our study was not without limitations. First, the use of the PTGT as a measurement tool has been previously established as highly reliable but has not been validated against imaging studies.\textsuperscript{2,8} However, the PTGT has been used in the literature to detect changes and restrictions in posterior talar glide in individuals with a lateral ankle sprain,\textsuperscript{2,8} making it an appropriate tool to use in the assessment of talocrural arthrokinematics. Second, the use of active ROM for the OKC measurement may not have captured the true osteokinematic motion that was occurring in the study participants; with the knee in an extended position, dorsiflexion ROM may have been limited to the flexibility of the gastronemius muscles. Third, we tested healthy participants. When compared with participants with ankle injuries, dorsiflexion ROM is less likely to be limited by pain or swelling and is more likely to be limited by muscular, ligamentous, or bony factors.\textsuperscript{1,12} Therefore, inferences that have been made about the relationships between the dorsiflexion ROM measurements and talar glide in this study should be interpreted accordingly. Finally, we chose to use a bubble inclinometer to take dorsiflexion ROM measures; therefore, any comparison of our results with other ROM measurement techniques, including universal goniometry and weight bearing lung distance,\textsuperscript{16} must be made vigilantly.

CONCLUSION

Four significant relationships were found between the 4 different ROM measures and talar glide as measured with the PTGT and the talar displacement as measured with the ankle arthrometer. Talar glide, when measured with the PTGT, may be a meaningful tool for clinicians to use when assessing dorsiflexion ROM in a weight bearing position. Clinically, the PTGT allows clinicians to assess the arthrokinematic motion of the talocrural joint and has been used in the literature to assess restrictions in arthrokinematics at the talocrural joint in patients experiencing recurrent ankle sprains.\textsuperscript{2,7,8} The measurements of posterior talar glide used in this study provide proxy measures of talar glide. The PTGT uses knee flexion angle as a surrogate measure and the ankle arthrometer assesses talar glide by calculating the amount of calcaneal movement in relation to a fixed tibia. In the CKC, we observed a positive relationship between the standing dorsiflexion ROM measurements and talar glide. In the CKC, measurements of dorsiflexion may be a better indicator of the ROM that is available for functional tasks, compared with OKC measurements. The use of a functional measurement technique that maximizes the total available ROM and a clinical assessment tool that is capable of detecting arthrokinematic changes could be valuable for clinicians.

IMPLICATIONS FOR CLINICAL PRACTICE

Using a functional measurement technique that maximizes the total available ROM, and an assessment tool that is capable of detecting arthrokinematic restrictions and changes, may be useful for clinicians. Measurements of dorsiflexion in a weight bearing position may be a better indicator of ROM that is available during functional tasks, compared with non-weight bearing measurements of dorsiflexion. However, non-weight bearing measurements should still be used with injuries in which weight bearing is contraindicated.

REFERENCES


