Using an Arthrometer to Quantify Ankle Laxity

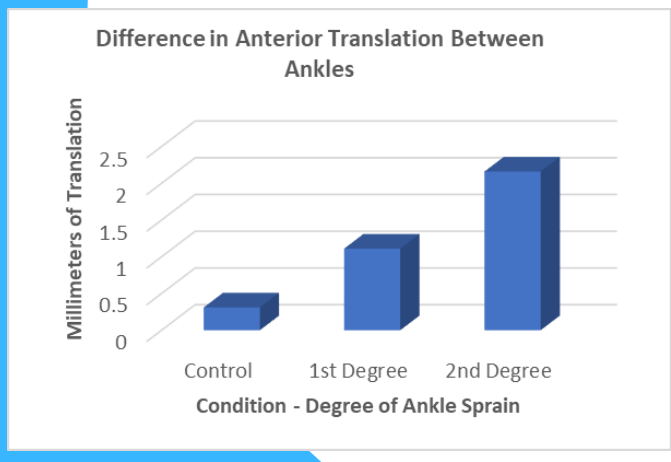
Lateral ankle sprains are a common musculoskeletal injury. The anterior talofibular ligament (ATFL) is the primary ligament involved and is assessed via an anterior drawer test. Clinically assessing joint laxity has been a subjective task. Evaluating both magnitude of translation & quality of the endfeel has presented challenges. The goal was to determine the ability of the arthrometer to objectively identify the anterior translation of the ankle and the relationship to the clinical diagnosis.

METHODS

- Study was explained & consent obtained
- Participants had a current lateral ankle sprain
- Other foot/ankle pathology or fracture as well as connective tissue disorders were excluded
- Contralateral ankle was be free of pathology
- Anterior drawer test was performed with the arthrometer on uninjured then injured ankle

RESULTS

- 10 participants each group: control, grade 1, & grade 2 sprain
- 20 female & 10 male
- Median age = 35.5 years
- Mean time from injury = 13.9 days
- Differences between injured (sprained) & uninjured ankles:
  - Control = 0.31 ± 0.47 mm
  - Grade 1 = 1.11 ± 0.52 mm
  - Grade 2 = 2.16 ± 0.85 mm
- Mann-Whitney U testing revealed all groups were significantly different



DISCUSSION

- Normal translation of an anterior drawer test has been reported to be from 3 – 10 mm with a mean of 2.00 mm ± 1.71 mm using stress radiographs
- This is too big of a range to use absolute measures; comparison to uninjured ankle needs to be the standard
- ATFL ratio = ATFL stress/ATFL resting:
  - Grade 1 sprains ratio = 1.1 +/- 0.1
  - Grade 2 sprain ratio = 1.3 +/- 0.2
  - Grade 3 sprain ratio = 1.4 +/- 0.2
- Current data is similar:
  - Grade 1 sprain ratio = 1.27 +/- 0.1
  - Grade 2 sprain ratio = 1.67 +/- 0.3
- This is consistent with a prior study reporting sectioning the ATFL increased anterior laxity by 2 mm

CLINICAL RELEVANCE

- Anterior drawer test is the gold standard for clinical ATFL testing but the subjective nature has challenges
- The use of an arthrometer to assess ankle joint laxity enhances the objectivity of patient assessment & throughout the recovery process

FDA-cleared; Patent 11,123,007
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ABSTRACT

Background: Lateral ankle sprains are a common musculoskeletal injury. The anterior talofibular ligament (ATFL) is the primary ligament involved and is assessed via an anterior drawer test. Clinically assessing joint laxity has been a subjective task. Evaluating both magnitude of translation & quality of the endfeel has presented challenges. Until recently, a reliable and valid arthrometer to test joints other than the knee have not been available. The Mobil-Aider arthrometer has undergone bench testing for validity, reliability testing in healthy individuals, and most recently the testing of individuals for pathology. A summary of these studies is available in a supplemental document. The goal of this study was to determine the ability of the arthrometer to objectively identify the anterior translation of the ankle and the relationship to the clinical diagnosis. **Methods**: The participant was evaluated by a physician and magnitude of ankle sprain was determined. An arthrometer was used to perform an anterior drawer test (uninjured before injured, three measures each) in the prone position. Both clinicians were blinded to the data of the other. **Results**: There were 30 participants, 10 per group (uninjured, 1° sprain, 2° sprain). Mann-Whitney U testing found significant differences between the control and grade I ankle sprain groups ($p < .001$), the control and grade II ankle sprain groups ($p < .001$), and the grade I and grade II ankle sprain groups ($p = .004$). There was ± 0.31 mm difference in anterior translation between healthy ankles. Whereas there was 1.11 mm and 2.16 mm difference between ankles in grade 1 and grade 2 sprains, respectively. **Discussion:** Anterior drawer test is the gold standard for clinical ATFL testing but the subjective nature has challenges. Technology is available to assess ankle joint laxity enhances the objectivity of patient assessment and throughout the recovery process. An arthrometer is a valuable tool in quantifying orthopedic examination.

Key Words: ankle sprain, arthrometer, ankle instability

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Using an Arthrometer to Quantify Ankle Laxity: Supportive Studies of Validity and Reliability of Device Used

Background: Clinically assessing joint laxity has a significant subjective component. Evaluating both magnitude of translation and quality of the endfeel has presented challenges. An arthrometer can provide objective data on the magnitude of translation but until recently, they were only capable of assessing the knee. The Mobil-Aider arthrometer (US patent 2021) is a digital device with attachments for five joints can now provide objective measures of the linear translation, i.e., arthrokinematics motion. The seven attachments are used for the shoulder, elbow, wrist, knee, and ankle. To provide some background to the development of this arthrometer. Several studies have been performed over the past couple years to first assess the validity of the device with bench research, progress to the reliability on normal individuals and then on to clinical research with pathology. This stepwise sequence is very important to be able to support the use of a device in a clinical setting.

Methods: Specifically, the sequence of studies began with the arthrometer validated via a Zeiss Smartzoom (study 1) and shoulder testing with an electro-magnitude motion analysis device (study 2). A case study on a knee compared the device to a radiographic image (study 3). The reliability was assessed in healthy shoulders and wrists (study 4 and 5). The clinical application was performed on anterior cruciate ligament (ACL) injuries (study 6) and lateral ankle sprains (current study).

Results: This series of studies are summarized as follows:

Study 1 assessed the digital reading of the Mobil-Aider compared to the Zeiss Smartzoom (bench research/no human participants) and was found to be highly correlated (0.986).[4]

Study 2 placed an electro-magnetic (EM) motion analysis device on the shoulders of 20 healthy individuals and compared the EM measure with that of the Mobil-Aider. The correlation for posterior glenohumeral (GH) glides was 0.83.[7]

Study 3 was a single case report in which the measurement of anterior translation of the tibia on the femur was compared on radiographic (6.96 mm) to that of the arthrometer (7.10 mm).[2]

Study 4 and 5 examined intra-rater reliability (ICC3, K) of GH and radiocarpal (RC) glides in 21 and 24 healthy participants, respectively. The reliability (ICC3, K) for a GH posterior glide was 0.771 and for the RC volar glide was 0.904.[6,8]

Study 6 examined 26 individuals with a reported knee injury. The Mobil-Aider arthrometer was used to assess ACL laxity via a Lachman test. The results were compared to an MRI. When no tear was present the translation of the two knees were within 0.18 mm of each other. When a partial or complete tear was identified via MRI, the differences were 2.05 mm and 3.38 mm, respectively.[5]

Finally, **study 7** (the current infographic) examined lateral ankle sprains. There was ± 0.31 mm difference in anterior translation of the talocrural joint between healthy ankles. Whereas there was 1.11 mm and 2.16 mm difference between ankles in grade 1 and grade 2 sprains, respectively.

Discussion-Conclusions: This research process demonstrates the process of validating an orthopedic device from bench research to healthy participants to the identification of the magnitude of pathology. All studies involved blinding of the researchers. All studies were adequately powered to provide relevant clinical data.

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