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Assessment of Gastrocnemius Flexibility Using the Active Ankle Dorsiflexion Test and Silfverskold Test

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Research Article

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Abstract

Background

Gastrocnemius tightness is a musculoskeletal disorder, which restricts ankle dorsiflexion and impairs normal gait mechanics, with the possibility of developing a number of lower-limb pathologies. The correct evaluation is critical in early detection and avoidance of complications.

Objective

The purpose of the study was to assess the diagnostic accuracy of the Active Ankle Dorsiflexion Test (AADT) to diagnose gastrocnemius tightness when compared with the Silfverskiöld test as a reference standard.

Methods

A cross-sectional prospective multicenter diagnostic study was done on 100 adults (18–30). The participants were tested on AADT and Silfverskiöld. Sensitivity, specificity, predictive values, and receiver operating characteristic (ROC) curves were used to analyze diagnostic performance.

Results

55% of the participants had been diagnosed with gastrocnemius tightness. The AADT was sensitive with high sensitivity (84.6) but low specificity (22.9), which implies that the test has high capability to identify true positive but low ability to rule out non-cases. The diagnostic accuracy of ROC analysis was good to excellent (AUC: 0.861–0.894), whereas passive dorsiflexion measures were a bit better (AUC: 0.902–0.922). Knee flexed measurements were more accurate compared to extended positions.

Conclusion

The Active Ankle Dorsiflexion Test is a good and sensitive screening test of gastrocnemius tightness but should not be used to make a diagnosis since its specificity is low. Its combination with standard tests such as the Silfverskiöld test increases the accuracy of diagnosis and clinical decision-making.

INTRODUCTION

A typical musculoskeletal issue impacting flexibility is muscle tightness, which restricts range of motion. (Psarakis et al., 2025) Also known as isolated gastrocnemius tightness, gastrocnemius tightness, or gastrocnemius equinus, is a loss of ankle dorsiflexion with a straight knee, but an improvement with a flexed knee.(Jeong et al., 2021) This is clinically significant due to the fact that the gastrocnemius crosses the knee and ankle joints as opposed to the soleus, which only acts on the ankle.(Morgan et al., 2020)

A decreased ankle dorsiflexion may disrupt normal gait, and result in compensatory strategies like premature heel lift off, excessive foot pronation, increased forefoot load, and changed knee and hip motion.(Cady, Croix, & Deighan, 2021) These alterations could cause ailments like plantar fasciitis, Achilles tendinopathy, metatarsalgia, stress fractures, knee pain, hip issues, and lower back dysfunction. Gastrocnemius tightness could be age-related and can have an impact on everyday life, mobility, activities, and quality of life.(Rathi & Sahasrabuddhe, 2021)

The gastrocnemius flexibility and ankle dorsiflexion may be assessed using non-weight-bearing, weight-bearing and instrumental methods. Some of the common techniques are goniometric measurement, the active ankle dorsiflexion test, the lunge test, and the Silfverskiöld test.(Chiu, 2021) The Silfverskiöld test will be particularly helpful, as it will aid in the differentiation of isolated gastrocnemius tightness versus soleus or joint capsule restrictions by comparing ankle dorsiflexion with the knee extended and flexed. (Hernández-Guillén & Blasco, 2020)

Nevertheless, the most effective and valid clinical test is still contested. It is significant to compare these assessment techniques to enhance the diagnosis, treatment directions, and lower-limb injuries prevention.(Kempfert et al., 2025)

Methodology

The multicenter prospective cross-sectional diagnostic accuracy study was done to evaluate the Active Ankle Dorsiflexion Test in identifying the gastrocnemius tightness by use of the gold standard test, which is the Silfverskiöld test. Data collection was preceded by obtaining ethical approval and informed consent.

The sample size was estimated using G*Power software, a two tailed independent t-test, alpha level of 0.05, power of 0.80 and effect size of 0.57, which gave a sample of 100. Adults aged 1830 years with tightness or gastrocnemius tenderness and occupation with prolonged standing were selected in various hospitals and clinics. Those with neurological conditions, systemic foot or ankle disease, prior surgery or trauma, fixed deformities, structural dorsiflexion limitation, or medications impacting muscle tone were excluded.

Both tests were performed on each participant. In the case of the Active Ankle Dorsiflexion Test, the subjects were seated with their knees straight and the ankles above the table and then actively dorsiflexed the ankle as much as possible. A handheld goniometer was used to determine the angle. In the case of the Silfverskiöld test, passive ankle dorsiflexion was assessed during an unstable position (supine with the knee in extended position and flexed to 90 degrees). Higher dorsiflexion with knee flexion was an indication of isolated gastrocnemius tightness.

Descriptive statistics, intraclass correlation coefficients to assess inter-rater reliability, 2 x 2 tables to assess sensitivity, specificity, PPV and NPV, and ROC analysis to assess AUC were used to analyze the

data. The diagnostic value and clinical applicability of Active Ankle Dorsiflexion Test was determined using results.

Results

Participant Characteristics

A total of 100 participants were included in the study. Of these, 52% were female and 48% were male. The mean age was 25.17 ± 3.46 years (range: 18–30 years). The majority belonged to the middle socioeconomic group (88%). Occupational distribution included workers (45%), students (35%), homemakers (12%), and teachers (8%). Mean body weight and height were 68.23 ± 10.38 kg and 166.52 ± 8.92 cm, respectively.

Disease Status

According to the reference standard (Silfverskiöld test), 55 participants (55%) were diagnosed with gastrocnemius tightness, while 45 participants (45%) were classified as non-diseased.

Diagnostic Accuracy

The comparison between the Active Ankle Dorsiflexion Test (index test) and the reference standard is presented in Table 1.

Table 1
Diagnostic outcomes of the index test compared with the reference standard

Index Test Positive	**Reference Standard Positive**	**Reference Standard Negative**	**Total**
	55 (True Positive)	**27 (False Positive)**	**82**
Index Test Negative	10 (False Negative)	8 (True Negative)	18
Total	65	35	100

A statistically significant association was observed between the index test and disease status ($\chi^2 = 26.83$, $p < 0.001$).

Diagnostic Performance

The diagnostic performance parameters are summarized in Table 2.

Table 2
Diagnostic performance of the Active Ankle Dorsiflexion Test

Test	Sensitivity	Specificity	PPV	NPV
Index Test	84.6%	22.9%	67.1%	44.4%

The index test demonstrated high sensitivity but low specificity, indicating that it is more suitable as a screening tool rather than a confirmatory diagnostic test.

ROC Curve Analysis

Receiver operating characteristic (ROC) analysis showed that index-based ankle dorsiflexion measurements had good to excellent diagnostic accuracy. The Active Dorsiflexion Index yielded area under the curve (AUC) values ranging from 0.861 to 0.894. The Passive Dorsiflexion Index demonstrated superior performance, with AUC values between 0.902 and 0.922. Measurements performed with the knee flexed consistently showed higher diagnostic accuracy than those obtained with the knee extended.

Summary

Overall, index-based ankle dorsiflexion measurements demonstrated high sensitivity but limited specificity, supporting their role as effective screening tools for gastrocnemius tightness in young adults.

DISCUSSION

The aim of the study is to determine the diagnostic accuracy of active and passive ankle dorsiflexion to detect gastrocnemius tightness by comparison with a reference standard. The results indicate that the index test was sensitive (84.6%), with statistically significant correlation with disease status, which means that it can be useful as a screening tool.

Nevertheless, the low specificity (22.9) indicates that it can poorly rule out non-diseased people.(Wang & Li, 2025) This could be the reason why the number of false-positive results was relatively high in the study. These findings suggest that although the index test is useful in the diagnosis of disease, it cannot be applied as a single diagnostic instrument.

The analysis of ROC curves also revealed that index-based measures of ankle dorsiflexion performance were better than single position measures in terms of diagnostic accuracy. Both active and passive dorsiflexion indices had excellent to outstanding AUC values, which confirmed their clinical relevance. (Haldar et al., 2021) The diagnostic accuracy of measurements in the flexion position of the knee was always higher than that of the measurements in the extension position of the knee, which is probably explained by a decrease of gastrocnemius tension and better isolation of muscle tightness.(Adillón et al., 2022)

The study population was predominantly made up of young adults and this could be indicative of an increased prevalence of lower limb conditions related to activity. Although this increases clinical applicability in active populations, it can reduce generalizability to older or less active populations.(Lôbo, Bordalo-Rodrigues, & Group, 2021)

Generally, the results endorse the application of combined dorsiflexion indices to enhance diagnostic accuracy and minimize the use of individual clinical tests.(Arellano et al., 2025)

CONCLUSION

Ankle dorsiflexion index measures showed a higher diagnostic accuracy over dorsiflexion alone measures. The Active Ankle Dorsiflexion Test was highly sensitive, and significantly associated with gastrocnemius tightness, and can be utilized as a screening method in clinical practice. It is however limited in its specificity and therefore should be applied with the already established diagnostic procedures, like the Silfverskiöld test so as to make proper clinical decisions.

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