Manual Examination Underperforms to Estimate Joint Laxity and Anterolateral Ligament Tears in Ankles with Previous Sprain: a Correlation Study Using Instrumented Stress Testing within MRI with the Porto Ankle Testing Device (PATD)

Renato Andrade, Bruno S. Pereira, Eluana Gomes, Cristina Valente, Adriana Gonçalves, Daniela Dantas, Carlos Macedo, João Paulo Vilas-Boas, C. Niek van Dijk, João Espregueira-Mendes

Clínica Espregueira – FIFA Medical Centre of Excellence

PORTO, PORTUGAL

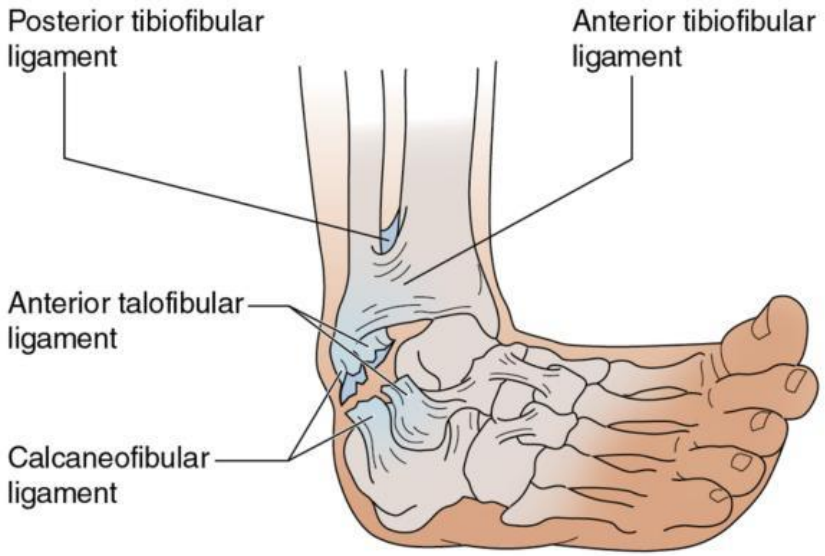
DISCLOSURE STATEMENT

- João Espregueira-Mendes participates in the MultiJoint patent (US10470700B2) that includes the Porto Ankle Testing Device (owned by Saude Atlântica – Gestão Hospitalar, S.A.)

- He does not receive any royalties or fees regarding the MultiJoint patent (US10470700B2).

BACKGROUND

- Lateral ankle sprain is the most frequently reported musculoskeletal injury in physically active individuals [1,2].
- A tear to the anterolateral ankle ligaments can result in ankle joint laxity and lead to mechanical ankle instability.
- Assessment of ankle joint laxity has been a cornerstone step in the diagnosis of patients with instability, with important implications for treatment indications.



[1] Herzog et al (2019). J Athl Train, 54(6):603-610.

[2] Shah et al. (2016) Sports Health, 8:547–552.

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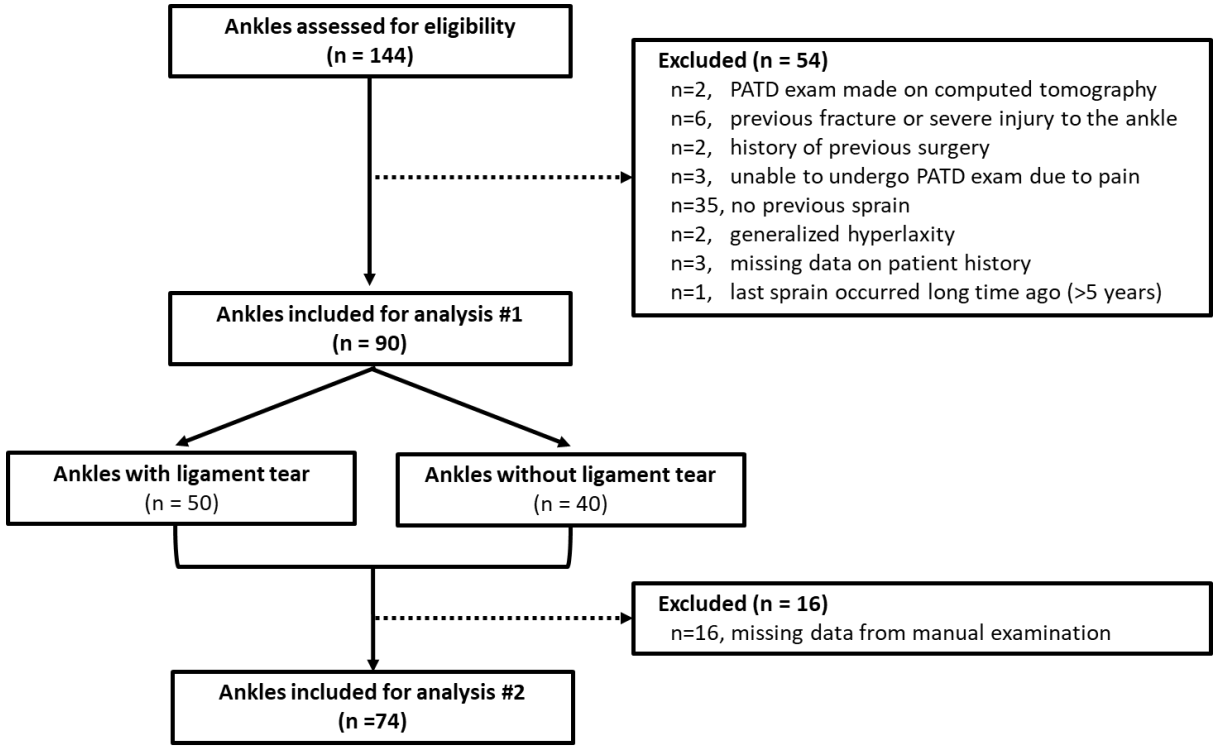
PURPOSE

The purpose of this study was to evaluate joint laxity of ankles with and without a previous anterolateral ligament tears using an arthrometer compatible with magnetic resonance imaging (MRI) – the Porto Ankle Testing Device (PATD) - and compare its diagnostic performance against manual examination.

METHODS

Prospective case series (Porto, Portugal)

- This study enrolled 90 ankles with previous ankle sprains, of which 50 had a previous anterolateral ligament tear (confirmed by MRI).
- All ankles underwent manual physical examination (anterolateral drawer and talar tilt tests) by an experienced Foot and Ankle Orthopaedic surgeon and evaluated with MRI by a musculoskeletal radiologist.
- All ankles also underwent instrumented stress testing with the PATD within MRI setting.



METHODS

- Age, sex and body mass index were homogenous across those with and without previous ligament tears.
- Ankles with previous ligament tears were more common on right ankles and displayed higher instability symptoms and more functional impairments in daily activities and sports.

Characteristics	Previous ligament tear (n=50)	Intact ligaments (n=40)	*P value*
Sex. n (%)			
Male	26 (52%)	16 (40%)	0.257
Female	24 (48%)	24 (60%)	
Age (mean ± SD)	31.2 ± 12.4	34.3 ± 10.4	0.300
BMI (mean ± SD)	25.0 ± 12.4	25.3 ± 4.6	0.695
Ankle side (n - %)			
Right	32 (64%)	16 (40%)	**0.023**
Left	18 (36%)	24 (60%)	
CAIT (mean ± SD)	12.6 ± 7.6	19.7 ± 8.2	**< 0.001**
FAAM ADL (mean ± SD)	88.3 ± 16.4	95.1 ± 9.8	**0.001**
FAAM Sport (mean ± SD)	59.3 ± 31.1	80.25 ± 24.78	**< 0.001**

Legend: SD = Standard Deviation; BMI = Body Mass Index; CAIT = Cumberland Ankle Instability Tool; FAAM = Foot and Ankle Ability Measure; ADL = Activities of Daily Living.

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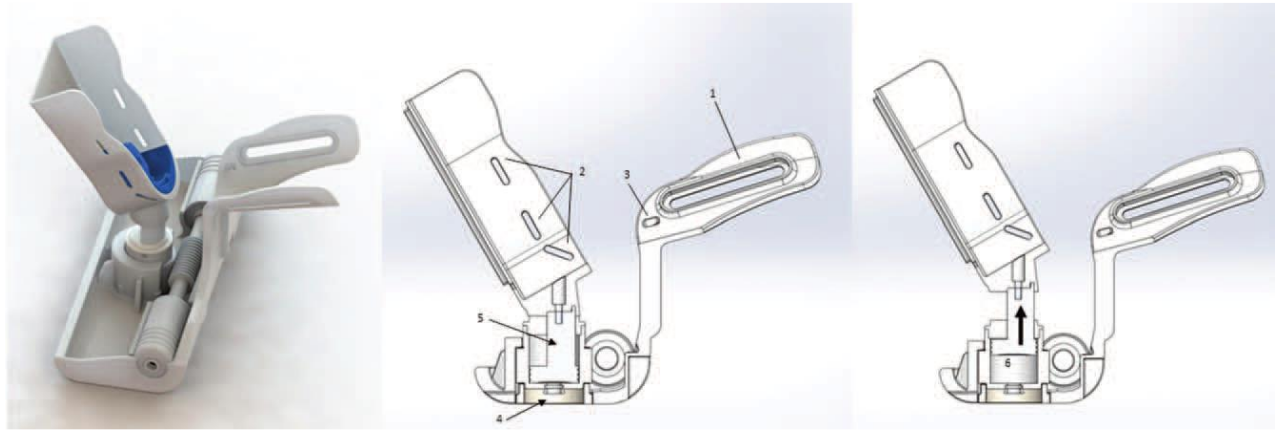
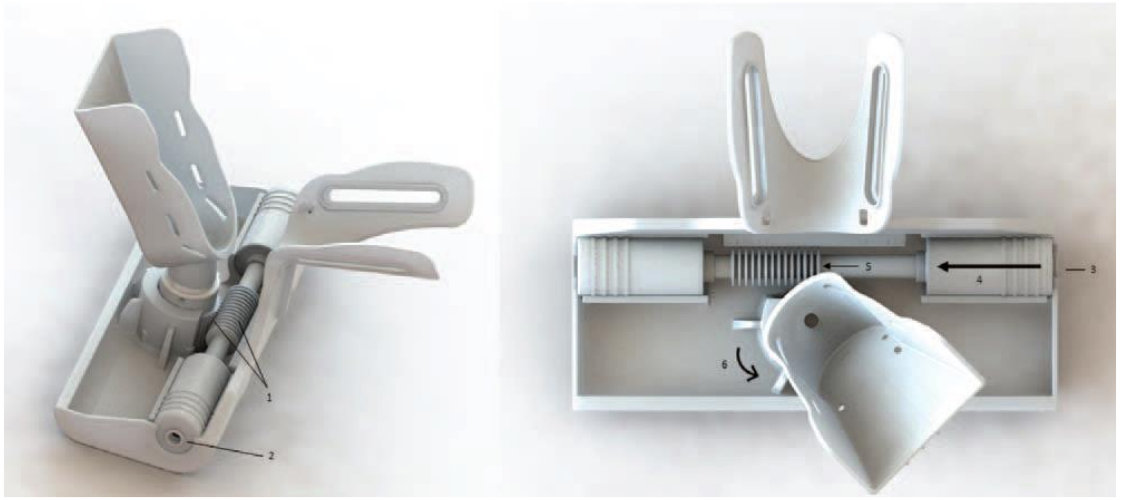
METHODS

- The PATD applies external stress to the ankle joint aiming to mimic the anterolateral drawer (posteroanterior translation with internal rotation) and the talar tilt manual tests within the MRI [3].
- The PATD has previously shown to be a reliable method to measure ankle and subtalar laxity [4].





[3] Andrade et al. (2021) Porto Biomed J, 6:1(e122).

[4] Andrade et al. (2025) J ISAKOS, Doi: 10.1016/j.jisako.2025.100851.

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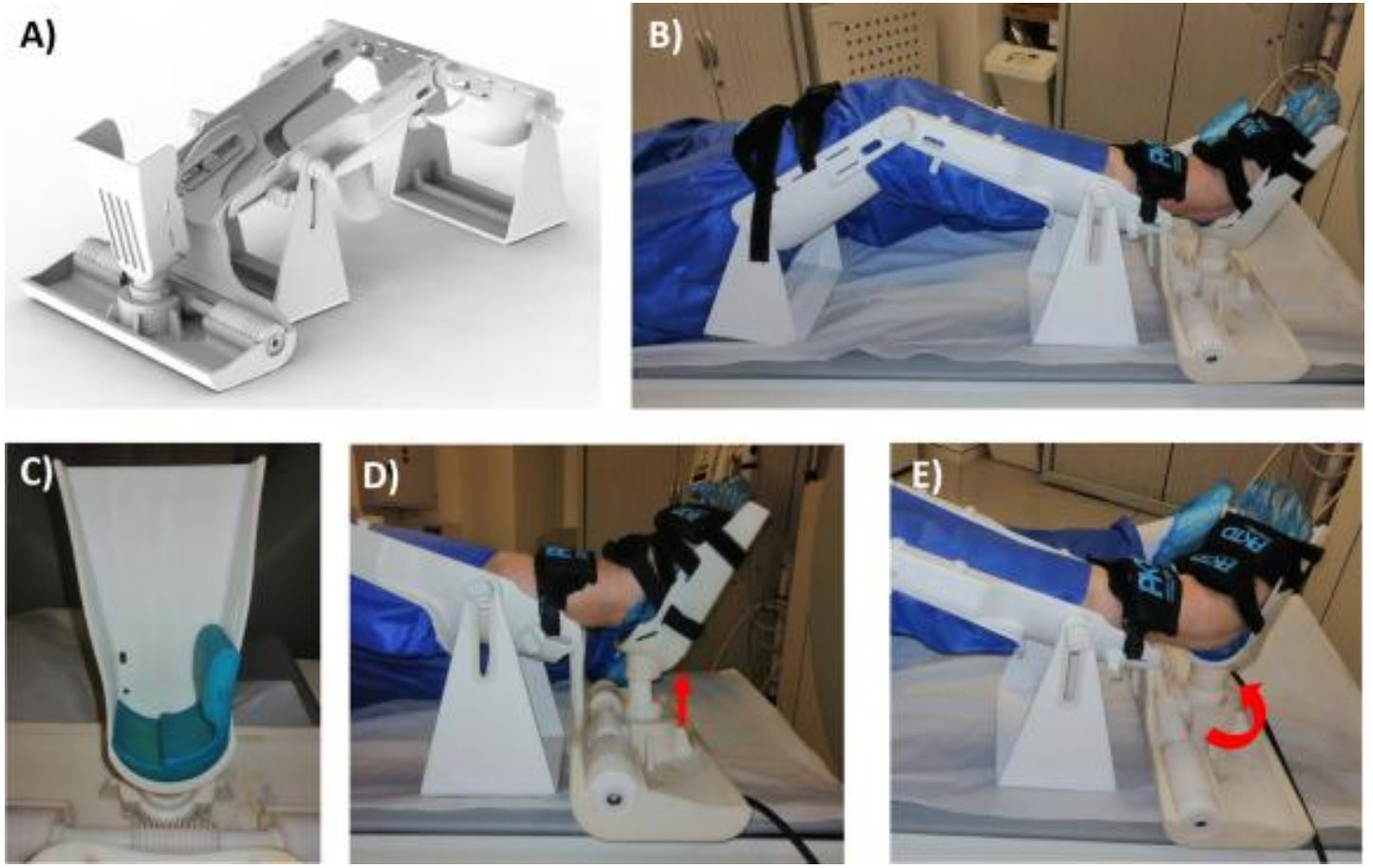
METHODS

- The PATD is the ankle modular component that attaches to larger device (PKTD) to support and positioning of the lower limb (Figure A).
- Lower limb is placed in the device with the knee flexed at 50 degrees and the ankles in slight plantarflexion (15 degrees) and in neutral rotation and is recorded the rest position (Figure B) .
- A scaffold is added to the foot platform to add internal rotation (Figure C) and the anterolateral drawer is performed (Figure D).
- The talar tilt test with varus and inversion stress is then performed (Figure E).



Evaluation procedure with the Porto Ankle Testing Device (PATD):
(A) design of the PATD; (B) set up in the resting position; (C) placement of the scaffold for anterolateral drawer (for a right ankle); (D) anterolateral drawer test with posteroanterior stress and internal rotation; (E) talar tilt test with varus and inversion stress [3].

[3] Andrade et al. (2025 J ISAKOS, Doi: 10.1016/j.jisako.2025.100851.

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METHODS

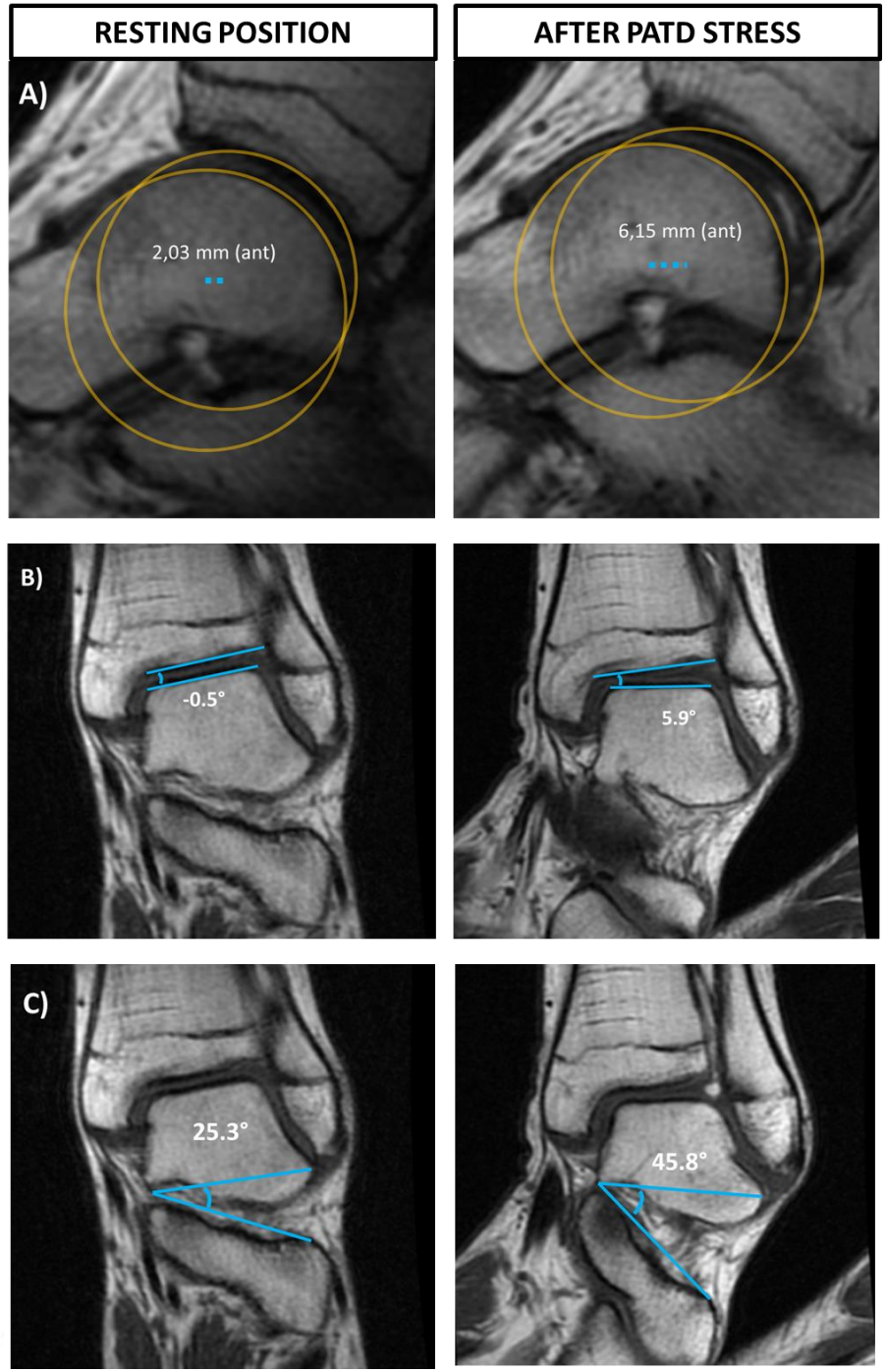
- Ankle and subtalar laxity was calculated as the difference of joint position before and after stress testing for:
  - anterior talus translation (ATT)
  - talar tilt (TT)
  - subtalar tilt (STT)
- Details on measurements are provided elsewhere [4].

[4] Andrade et al. (2025) J ISAKOS, Doi: 10.1016/j.jisako.2025.100851.

ATT

TT

STT



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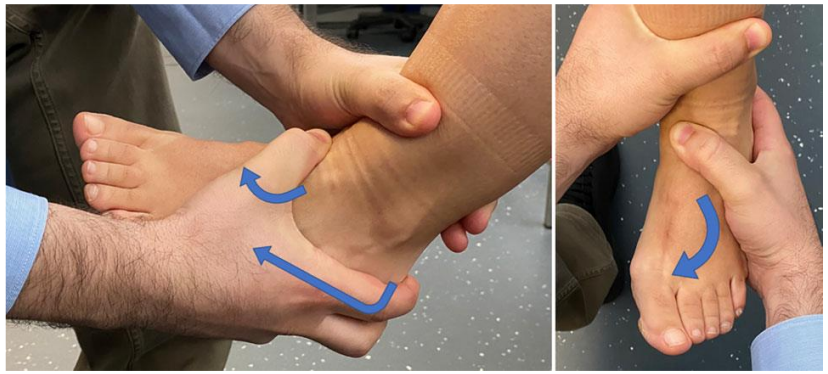
RESULTS

Results of manual examination

- The anterolateral drawer test (ALDT) showed that there was generally no laxity (n=26, 28.9%) or moderate to severe laxity (n=40, 54.1%). Only 5 ankles had minor sagittal laxity (5.6%) and 3 ankles very large sagittal laxity (3.4%).



ALDT

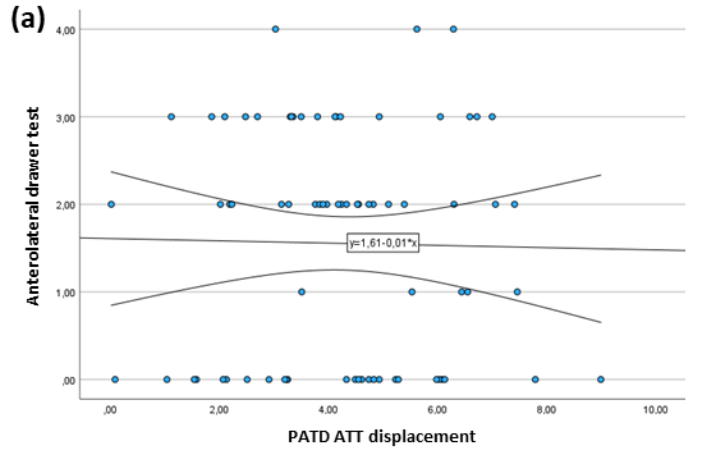
- The results of the varus talar tilt test (VTTT) showed that around half of ankles were stable (n=42, 46.7%), with remaining other being slight opening (n=22, 33.3%) or large opening (n=10, 33.3%).

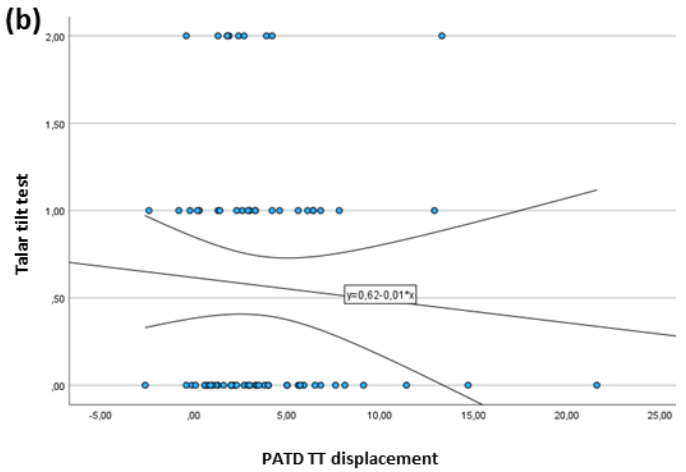
VTTT

RESULTS

- Manual exam showed very weak Spearman's rho values when compared to the PATD evaluation:
  - anterolateral drawer (ρ=-0.030, p=0.797)
  - talar tilt test (ρ=-0.057, p=0.627)

- Manual exam showed poor validity in correctly estimating ankle laxity in more extreme cases, underestimating in cases of large laxity and overestimating in cases with lower laxity.





RESULTS

- Diagnostic accuracy was always superior in the PATD evaluation for either anterior talofibular ligament (ATFL) or calcaneofibular ligament (CFL) previous tears.
- The PATD ATT as the most sensible (82%) and the anterolateral drawer the most specific (80%) for ATFL tears
- The STT was the most accurate metric (sensibility, 67%; specificity, 58%) for CFL tears.

MRI results	Manual tests and PATD	Diagnostic testing results				Diagnostic accuracy (95% CI)		
		TP	FP	TN	FN	SEN	SPE	Accuracy
Previous ATFL tear	ALDT (+++/++++)	14	7	28	25	35.9% (21.2-52.8%)	80.0% (63.1-91.6%)	56.8% (44.7-68.2%)
	PATD ATT (≥ 3.33 mm)	32	17	18	7	82.1% (66.5-92.46%)	51.4% (34.0-68.6%)	68.5% (56.6-78.8%)
Previous CFL tear	Talar tilt test (++)	1	9	53	11	1.9% (0.1-9.9%)	55.0% (31.5-76.9%)	45.0% (33.4-57.0%)
	PATD TT (≥ 3.20°)	8	26	36	4	66.7% (34.9-90.1%)	58.1% (44.9-70.5%)	59.7% (47.6-70.9%)
	PATD STT (≥ 15.75°)	8	24	38	4	66.7% (34.9-90.1%)	61.3% (48.1-73.4%)	62.3% (50.3-73.3%)

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CONCLUSION

Manual examination underperforms the instrumented evaluation with the MRI-PATD protocol to estimate ankle joint laxity.

The PATD showed higher diagnostic accuracy to identify ankles with previous anterolateral ligament tears, but with suboptimal performance to exclude those with previous ankle sprains but with intact ligaments.

Both diagnostic approaches should be used in combination when diagnosing ankles with previous sprain to better ascertain the severity of ankle laxity and achieve a more accurate diagnosis.