



Lateral Ankle Sprain

ROAST

4. Clinical assessment



PICOT Brice :

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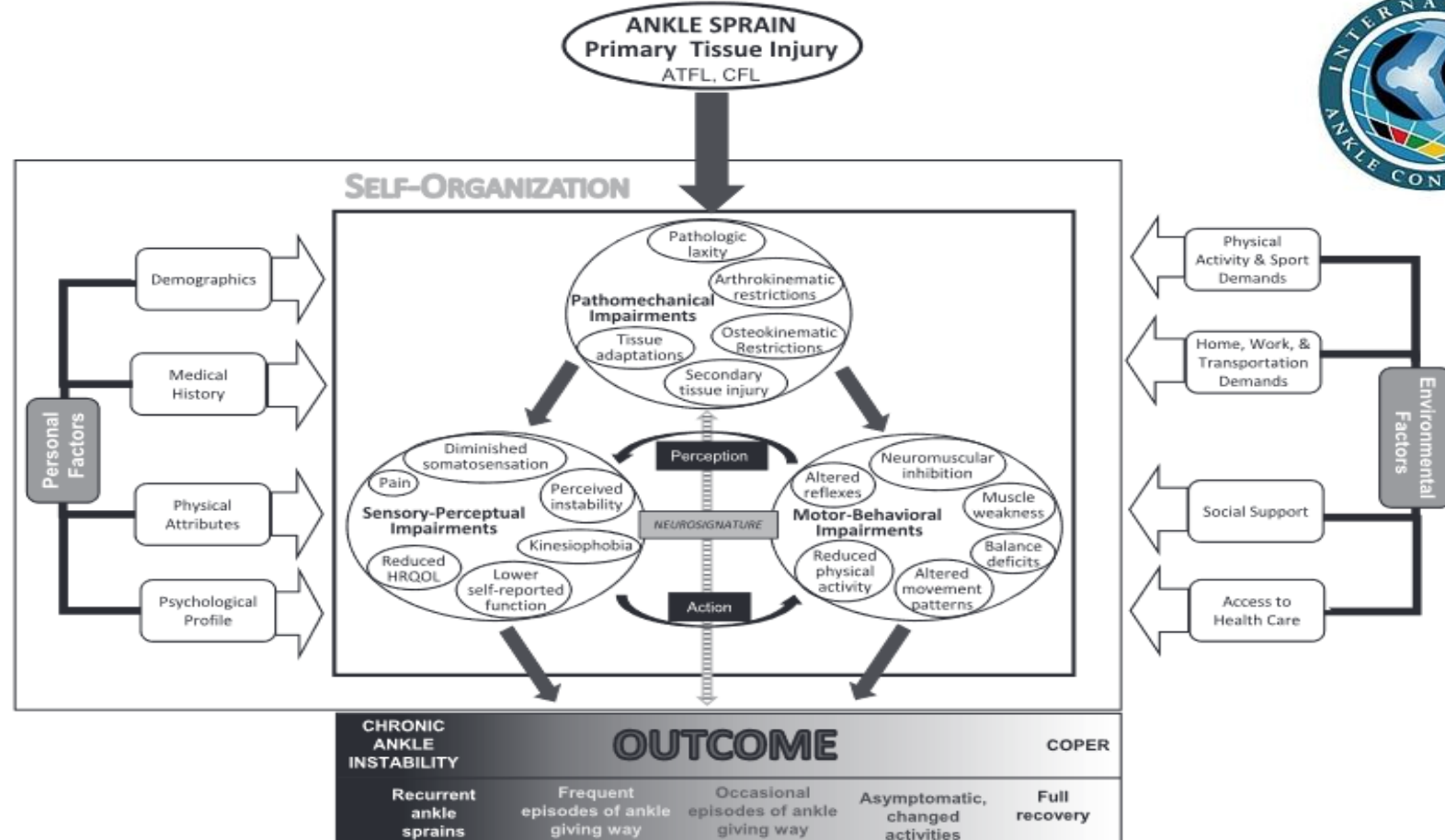


Figure 1. The updated model of chronic ankle instability (CAI). The outcome is determined at least 12 months after the initial ankle sprain. Abbreviations: ATFL, anterior talofibular ligament; CFL, calcaneofibular ligament; HRQOL, health-related quality of life.

ROAST (2019) : Rehabilitation Oriented ASsessment



Consensus statement

Clinical assessment of acute lateral ankle sprain injuries (ROAST): 2019 consensus statement and recommendations of the International Ankle Consortium

Eamonn Delahunt,^{1,2} Chris M Bleakley,³ Daniela S Bossard,^{1,2} Brian M Caulfield,^{1,4} Carrie L Docherty,⁵ Cailbhe Doherty,⁴ François Fourchet,⁶ Daniel T Fong,⁷ Jay Hertel,⁸ Claire E Hiller,⁹ Thomas W Kaminski,¹⁰ Patrick O McKeon,¹¹ Kathryn M Refshauge,⁹ Alexandria Remus,⁴ Evert Verhagen,¹² Bill T Vicenzino,¹³ Erik A Wikstrom,¹⁴ Phillip A Gribble¹⁵

- **Assess and quantify the deficits contributing to the cascade: sprain - recurrence – CAI – osteoarthritis**
- **Enable rehabilitation to be directed according to the deficits found: "à la carte rehabilitation".**

ROAST (2019)

Table 1 International Ankle Consortium ROAST

What clinicians should assess following acute lateral ankle sprain injury

Why?

How?

Ankle joint pain	Guide progression of exercise-based rehabilitation. Assess the efficacy of treatments implemented.	Numeric rating scale for pain. ³⁵ FADI. ³⁶
Ankle joint swelling	Swelling can cause arthrogenic muscle inhibition. Guide progression of exercise-based rehabilitation. Evaluate the efficacy of treatments implemented.	Figure-of-eight. ³⁸⁻⁴¹
Ankle joint range of motion	High propensity for the development of a dorsiflexion deficit. Impairments in ankle joint range of motion are consistently identified in individuals with CAI.	Weight-bearing lunge test. ⁴⁴⁻⁴⁶
Ankle joint arthrokinematics	Disruption in ankle joint arthrokinematics can result in a dorsiflexion deficit. Impairments in ankle joint arthrokinematics are regularly identified in individuals with CAI.	Posterior talar glide test. ⁴⁸
Ankle joint muscle strength	Impairments in ankle joint strength compromise the functional integrity of the ankle joint. Impairments in ankle joint strength are regularly identified in individuals with CAI.	Hand-held dynamometry. ⁵³
Static postural balance	Impairments in static postural balance are consistently identified in individuals with CAI.	BESS. ⁵⁶ FLT. ⁵⁷
Dynamic postural balance	Impairments in dynamic postural balance are consistently identified in individuals with CAI.	SEBT. ⁵⁸
Gait	Impairments in gait are consistently identified in individuals with CAI.	Visual assessment for antalgic gait.
Physical activity level	Guide the specificity of exercise-based rehabilitation.	Tegner activity-level scale. ⁶³
Ankle joint specific patient-reported outcome measures	Evaluate the efficacy of treatments implemented.	FADI. ³⁶ FAAM. ⁶⁵

BESS, Balance Error Scoring System; CAI, chronic ankle instability; FAAM, Foot and Ankle Ability Measure; FADI, Foot and Ankle Disability Index; FLT, Foot Lift Test; ROAST, Rehabilitation-Oriented AS-sessment; SEBT, Star Excursion Balance Test.

Assessments

Relationships with CAI

Best tests

Delahunt et al. (2019)

Pain assessment

Table 1 International Ankle Consortium ROAST

What clinicians should assess following acute lateral ankle sprain injury

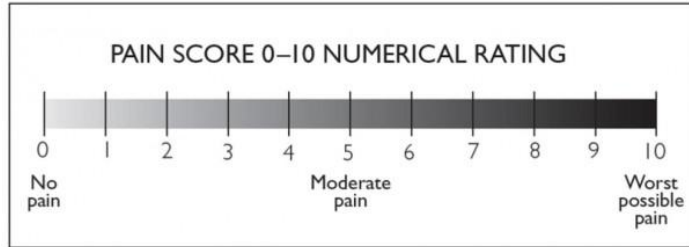
Why?

How?

Ankle joint pain

Guide progression of exercise-based rehabilitation.
Assess the efficacy of treatments implemented.

Numeric rating scale for pain.³⁵
FADI.³⁶



- Verbal or written form

- At rest and/or during various activities, after the session

- **Take care MDC = 1.5**



The Foot & Ankle Disability Index (FADI) Score

Clinician's name (or ref) _____

Patient's name (or ref) _____

Please answer every question with one response that most closely describes your condition within the past week. If the activity in question is limited by something other than your foot or ankle, mark N/A

	No difficulty at all	Slight difficulty	Moderate difficulty	Extreme difficulty	Unable to do
1. Standing	☐	☐	☐	☐	☐

- FADI & FADI Sport

- ENGLISH

- 0 à 100% (5 minutes)

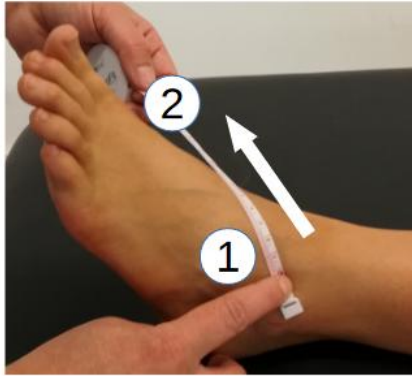
MDC = 3,6% (FADI)
MDC = 12,3% (FADIsport)

Oedema assessment

Ankle joint swelling

Swelling can cause arthrogenic muscle inhibition.
Guide progression of exercise-based rehabilitation.
Evaluate the efficacy of treatments implemented.

Figure-of-eight.³⁸⁻⁴



- ① Mi-distance jambier antérieur malléole externe
- ② vers l'intérieur (Tub navi)



- ③ base du 5^{ème} métatarsien
- ④ direction de la malléole interne



- ⑤ tendon d'achille puis malléole externe
- ⑥ point de départ

MDC no mark = 9,6mm

MDC mark = 7,3mm

Figure 11. Anterior-medial view of the figure-of-eight method of ankle swelling measurement.

Range of Motion – Dorsal Flexion



Ankle joint range of motion

High propensity for the development of a dorsiflexion deficit.
Impairments in ankle joint range of motion are consistently identified in individuals with CAI.

Weight-bearing lunge test.⁴⁴⁻⁴⁶

✓ Le **W**eight **B**earing **L**unge **T**est (WBLT)

- Hallux-wall distance in standing position
- Foot flat without lifting the heel.
- Contralateral foot backwards in a comfortable position
- Hands on the wall.



A difference of more than 3cm should concern the practitioner, minimum wall distance =10cm



Range of Motion – Dorsal Flexion



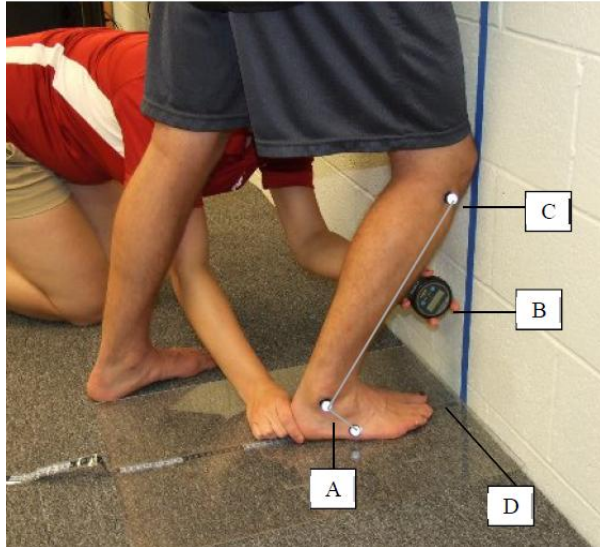
Strong correlation between 2D analysis ($r > 0.70$) and :

Centimetric ground measurement

Inclinometer 15cm below the ATT

Inclinometer on the ATT

MDC = 4.7° or 1.9 cm



Systematic review

Reliability and minimal detectable change of the weight-bearing lunge test: A systematic review



Cameron J. Powden ^{a,*}, Johanna M. Hoch ^b, Matthew C. Hoch ^b

“Subjects with the most inflexible ankles (34° of dorsiflexion range) had nearly five times the risk of suffering an ankle sprain as subjects with average flexibility (45° of dorsiflexion range).”

Arthrokinematics impairments

ORIGINAL ARTICLE

Talar Positional Fault in Persons With Chronic Ankle Instability

Erik A. Wikstrom, PhD, Tricia J. Hubbard, PhD



Table 2: Sagittal Plane Talar Position Group Means (mm), SDs, and 95% Confidence Intervals

Group	Ankle	Mean $\pm$ SD	95% Confidence Interval
CAI	Involved* [†]	3.7 $\pm$ 1.4	3.1–4.3
	Uninvolved	3.0 $\pm$ 1.6	2.3–3.7
Control	Matched involved	2.7 $\pm$ 1.2	2.1–3.2
	Matched uninvolved	2.8 $\pm$ 1.3	2.3–3.3

- A defect in the anterior positioning of the talus is present in CAI subjects compared to their healthy limb and compared to the matched limb of a control group.
- Excellent intra- and inter-tester reliability.

The Posterior Talar Glide Test

Ankle joint arthrokinematics

Disruption in ankle joint arthrokinematics can result in a dorsiflexion deficit.
Impairments in ankle joint arthrokinematics are regularly identified in individuals with CAI.

Posterior talar glide test.⁴⁸



- Posterior glide of the talus during passive dorsal flexion
- Patient seated at end of table
- Foot flat, Tibia vertical.



Reliability

The intratester reliability of the testing procedure of the investigator responsible for taking the measures in this study was taken from repeated trials (reflecting that of a single session of the main experiment) of 5 asymptomatic individuals outcome measure prior to the experiment commencing. The intratester reliability for posterior talar glide and weight-bearing dorsiflexion was estimated by calculating intratester intraclass correlation coefficients (ICC) and the standard error of the measurement (SEM). Analysis of the repeated trials revealed sound levels of reliability, with an ICC_{3,3} of 0.99 (95% CI, 0.96-0.99) for posterior talar glide and 0.95 (95% CI, 0.80-0.99) for dorsiflexion. The SEM was 0.4° for posterior talar glide and 0.2 cm for dorsiflexion.

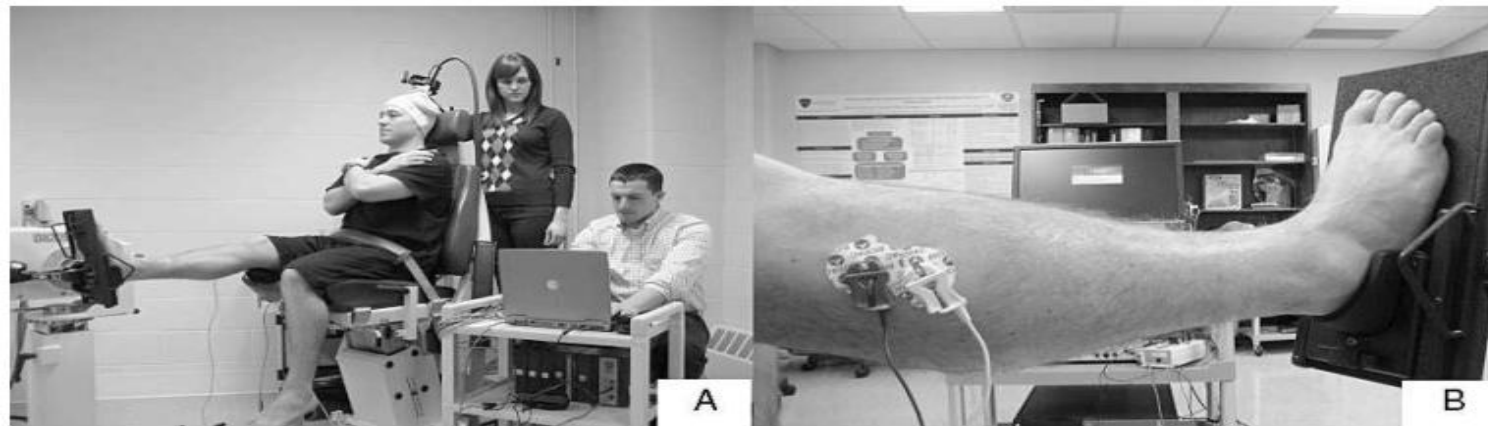
The examiner moves the foot backwards, blocking the advance of the talus with his thumbs. [?]
= the angle of passive flexion of the knee provides an estimate of posterior talar slippage.

MDC=1.4°

Normal values are approximately 16°, but have been reported as low as 2.5° in injured ankles...

Muscular impairments

Weakness exists and has a central origin



“Resting motor threshold and self-reported function were moderately correlated, suggesting **deficits in corticomotor excitability might influence function.** “. *Pietrosimone & Gribble(2012)*

Assessing muscle strength



Ankle joint muscle strength

Impairments in ankle joint strength compromise the functional integrity of the ankle joint.

Impairments in ankle joint strength are regularly identified in individuals with CAI.

Hand-held dynamometry.⁵³

Hand-Held Dynamometry: Reliability of Lower Extremity Muscle Testing in Healthy, Physically Active, Young Adults

Brent M. Kelln, Patrick O. McKeon, Lauren M. Gontkof, and Jay Hertel

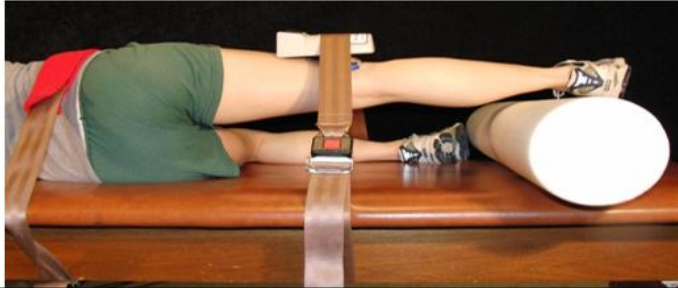


Comment avoir des données précises avec le dynamomètre à main ?

- Position the elbow orthogonal to the subject's strength.
- If possible, use a 'make test' value of repro. >
- Place ankle in neutral position at 90° flexion (strength/length relationship)
- Place the dynamometer at the head of the 5th metatarsal / 1st metatarsal
- 4-6 warm-up tests and 3 tests of 5 seconds of contraction
- Maximum force / subject's weight = N/kg

Hip Abductors

Lee & Powers (2014) have shown that patients with a strength deficit in the hip abductors have chronic ankle instability. Hence the interest in testing this function and restoring it if necessary...



HIP ABDUCTION (Willy and Davis, JOSPT 2011)



Normative values – Foot/Ankle evaluation

Literature

NORMES INVERSEURS : >28% BW
NORMES ÉVERSEURS : >29-31% BW
NORMES RELEVEURS : >29-35% BW
NORMES TRICEPS SURAL :
20-30 ans : 37 reps (H) / 30 reps (F)
30-40 ans : 33 reps (H) / 28 reps (F)
40-50 ans : 28 reps (H) / 25 reps (F)
50-60 ans : 28 reps (H) / 25 reps (F)
60-70 ans : 19 reps (H) / 19 reps (F)
70-80 ans : 14 reps (H) / 16 reps (F)

VS

Earl-Boehm et al. (2020)
Hébert Losier et al. (2017)
Kelln et al. (2008)

Our clinical practice

NORMES INVERSEURS & ÉVERSEURS :
>25% BW (activités « low-demand »)
>30% BW (activités « medium-demand »)
>35% BW (activités « high-demand »)
Ratio : 1.0-1.1

NORMES RELEVEURS : > 35-40% BW

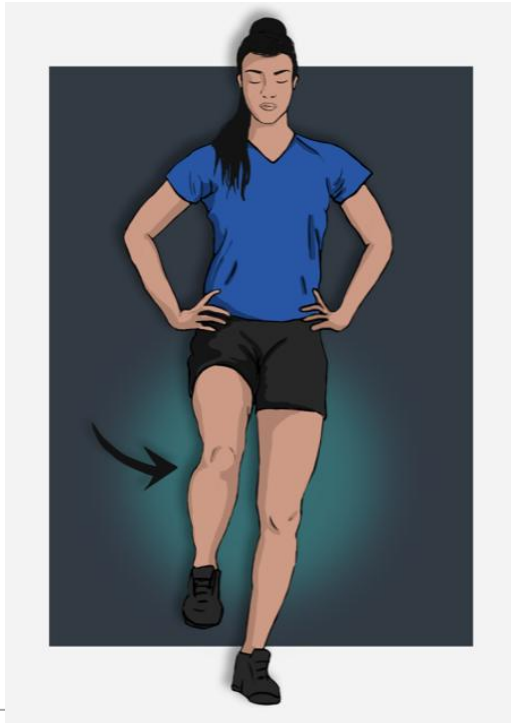
NORMES SOLÉAIRE :
>190% BW (activités « high-acceleration »)
>150% BW (activités « low-acceleration »)

Postural static Control, Single Leg Stance (SLS_{firm})

Static postural balance

Impairments in static postural balance are consistently identified in individuals with CAL.

BESS.⁵⁶
FLT.⁵⁷



- In unipodal support, on a stable surface with eyes closed for 20s.
- The loaded knee is slightly unlocked (5°).
- The contralateral limb is flexed
- Hands on hips
- Several familiarisation trials are allowed
- The number of "errors" is counted

ICC values of 0.93 and a SEM of 0.45; Cut off=3 erreurs

0 ERREURS



Type d'erreurs

Les mains se décolle des hanches

Le patient ouvre les yeux

Le patient déplace son pied, trébuche ou tombe

La hanche bouge à plus de 30° d'abduction ou flexion

L'avant ou l'arrière du pied en charge se lève

Le patient quitte la position de départ pendant plus de 5 secondes

5 ERREURS



Dynamic Postural Balance

Dynamic postural balance

Impairments in dynamic postural balance are consistently identified in individuals with SEBT.⁵⁸
CAI.

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CLINICAL COMMENTARY

The Star Excursion Balance Test: An Update Review and Practical Guidelines

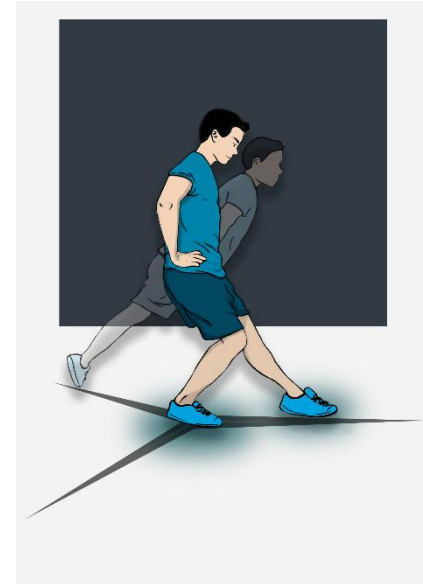
Brice Picot, PT, MSc^{1,2,3,4} Romain Terrier, PhD^{2,3,5} Nicolas Forestier, PhD^{3,4}
François Fourchet, PT, PhD^{2,4,6} and Patrick O. McKeon, PhD, ATC, CSCS⁷

¹French Handball Federation; ²French Society of Sport Physiotherapist; ³Savoie Mont-Blanc University;

⁴Laboratoire Interuniversitaire de Biologie de la Motricité; ⁵Whergo SARL; ⁶Hôpital de La Tour; ⁷Ithaca College

The Star Excursion Balance Test (SEBT) is a reliable, responsive, and clinically relevant functional assessment of lower limbs' dynamic postural control. However, great disparity exists regarding its methodology and the reported outcomes. Large and specific databases from various population (sport, age, and gender) are needed to help clinicians when interpreting SEBT performances in daily practice. Several contributors to SEBT performances in each direction were recently highlighted. The purpose of this clinical commentary is to (a) provide an updated review of the design, implementation, and interpretation of the SEBT and (b) propose guidelines to standardize SEBT procedures for better comparisons across studies.

Keywords: assessment, functional performance, lower limb, procedure, recommendations, reliability



“The **star excursion balance test** performed in three directions (anterior, posteromedial, and posterolateral) appears to be **the only test** to be **associated with increased injury risk**.”

Picot et al. @IJATT 2021, Hegedus et al. 2015, Gribble et al. @JAT 2012,

Dynamic Postural Balance

Dynamic postural balance

Impairments in dynamic postural balance are consistently identified in individuals with SEBT.⁵⁸
CAL.

Table 1 2021 Updated Recommendations for the SEBT Procedure

Important criteria	Recommendations
Number of directions	Three (ANT, PM, and PL) representing a “Y” instead of eight. ^{13,16,31} See the proposed compact versions (Figure 3).
Setup of the test	Demonstration prior to the test by the experimenter (or video). ^{7,17}
Number of familiarization trials	Four in each direction for both limbs, until familiarization with procedure. ^{7,17}
Number of recorded trials	Three per direction. ^{7,17} <i>Performances should be stabilized.</i> Switch from one leg to the other between each direction to avoid fatigue. ¹⁸
Hand position	Hands should remain on the hips to target lower limb performance. ^{14,21}
Foot placement	Barefoot (or socks), the most distal aspect of the great toe on 0 (crossroad of three lines) during the entire procedure. Need to be standardized across studies. This method avoids possible foot placement errors. ¹⁴
Failure criteria	(a) Subject falls or loses his/her balance (the reaching foot touch the ground). (b) Subject shifts his/her weight on the reach limb when contacting the floor or contacts the floor at multiple times or miss the tape measure. (c) Stance foot moves or heel rises or any part of the foot lifts from the ground. (d) Hands are removed from the hips.
Parameter	(a) Mean of the three trials for each direction and limb. ⁴⁶ (b) Calculation of the composite score (mean of three directions) for normalized (in percentage) and nonnormalized (in centimeters) scores. (c) Qualitative analysis of the movement. ^{56,57}
Limb length normalization	Scores are expressed as a percentage of the tested lower limb length (<i>from ASIS to medial malleolus preferably</i> , or lateral malleolus). ²¹

Note. ASIS = anterior and superior iliac spine; ANT = anterior; PL = posterolateral; PM = posteromedial; SEBT = Star Excursion Balance Test.

MDC :

Ant. -> 6% / 6cm

PM. -> 8% / 7cm

PL. -> 8% / 9cm

COMP= 7%

The Star Excursion Balance Test modified

- The loaded foot must not move, and the heel must not lift off.
- The hands must remain in contact with the hips
- The subject must not fall
- The subject must not transfer his/her body weight
- Between each trial, the foot is rested on the ground



Figure 5 : prise de mesure de la longueur du membre inférieur.
De l'épine Iliaque Antéro-supérieure et la malléole médiale



The Star Excursion Balance Test modified

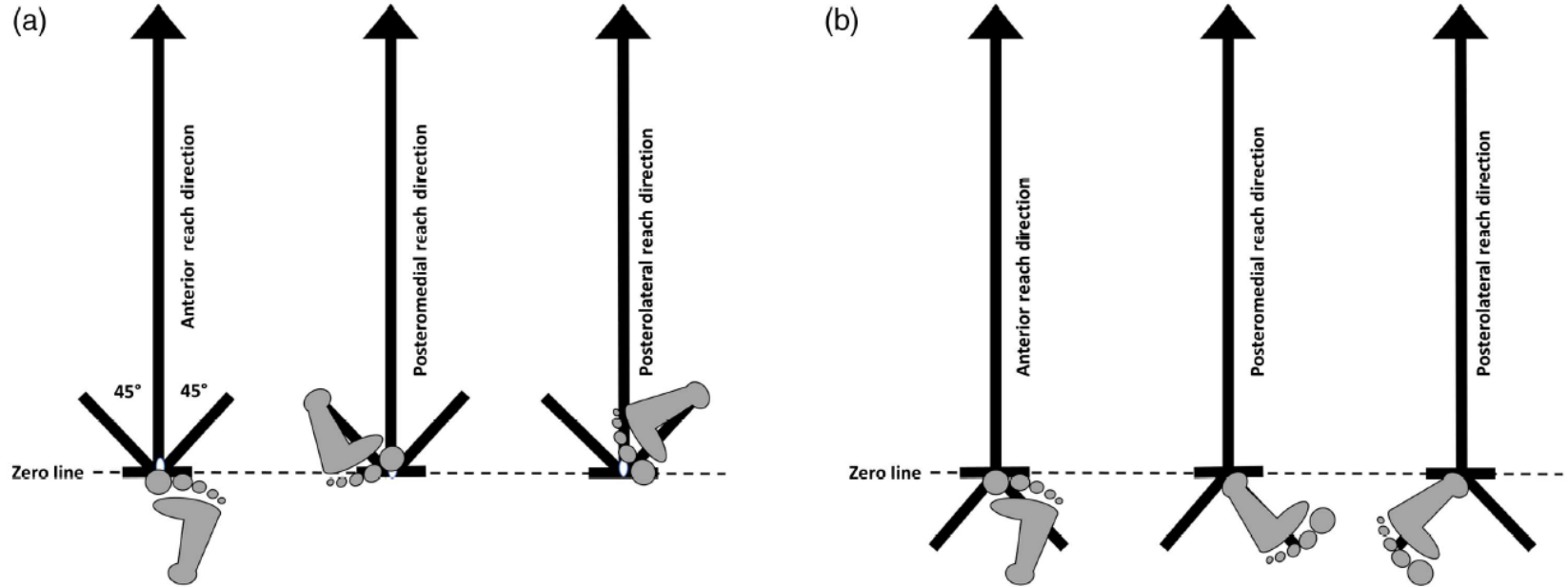


Figure 3 — A proposed “compact” version of the mSEBT. (a) With foot position in “toe fixed” at 0 for the three directions and (b) the changing toe/heel position according to the reached direction. mSEBT = modified Star Excursion Balance Test.

Dynamic postural control

Dynamic postural balance

Impairments in dynamic postural balance are consistently identified in individuals with SEBT.⁵⁸
CAI.

Review

Clinician-friendly lower extremity physical performance tests in athletes: a systematic review of measurement properties and correlation with injury. Part 2—the tests for the hip, thigh, foot and ankle including the star excursion balance test

Eric J Hegedus¹, Suzanne M McDonough², Chris Bleakley³, David Baxter⁴, Chad E Cook⁵

=> But... The limitation of the SEBT Test is its lack of specificity with respect to the ankle (Gribble et al. 2012, Nardone & Schiepatti 2010) and the divergence of the results obtained (Cug 2017).

Cut off point ?

Composite Score :

« **Female basketball players** with a composite reach distance **<94%** of their leg length were **6.5 times more likely** to have a lower extremity injury.” (Plisky et al. 2006)



TABLE 6. Adjusted odds ratios for potential lower extremity injury risk factors among high school basketball players.

Risk Factor	Category	LE Injury AOR [‡] (95% CI)
All players		
Normalized composite right reach distance*	≤94.0%	3.0 (1.5, 6.1)
Anterior reach distance difference [†]	≥4 cm	2.7 (1.4, 5.3)
Girls		
Normalized composite right reach distance*	≤94.0%	6.5 (2.4, 17.5)
Boys		
Anterior reach distance difference [†]	≥4 cm	3.0 (1.1, 7.7)

* Reach distance is reach distance divided by limb length multiplied by 100. Right reach done by standing on left limb and reaching with the right limb.

[†] Difference between right and left anterior reach distances.

[‡] Adjusted odds ratio for gender, grade, previous injury, participation in a neuromuscular training program since initial measurement, and lower extremity tape/brace use.

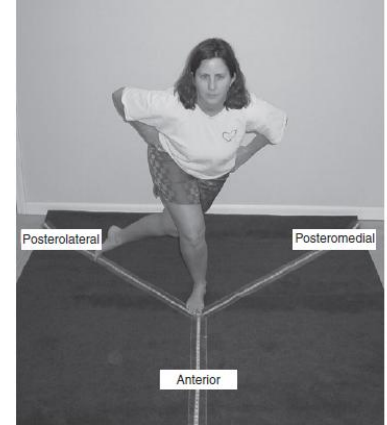


FIGURE 1. Star Excursion Balance Test with reach directions labeled in reference to right stance foot.

Anterior direction:

“side-to-side **asymmetry** in the **anterior direction(...)**, **discriminated** between injured and noninjured athletes” (Stiffler et al. 2017)

Semble être prédictif de blessures du membre inf: **> 4.5% ou 4 cm** (Plisky et al. 2006, Smith et al. 2015)

Assessment of the excursion of the centre of pressure when walking

3D Roll-offs

N/cm²

20

19

18

17

16

15

14

13

12

11

10

9

8

7

6

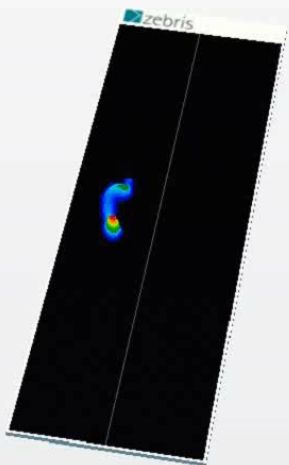
5

4

3

2

1



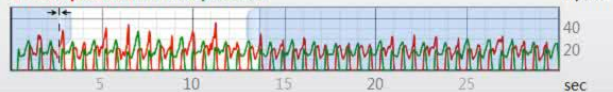
HD Pro Webcam C920

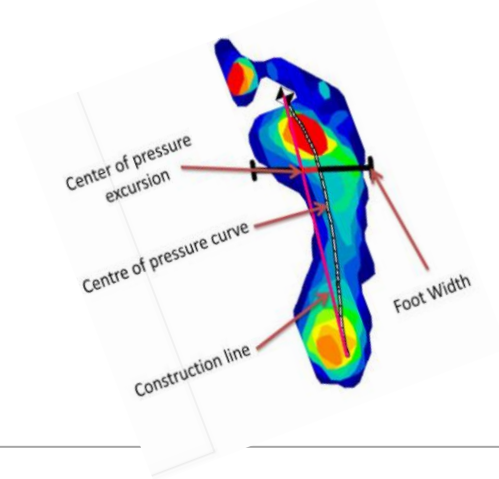
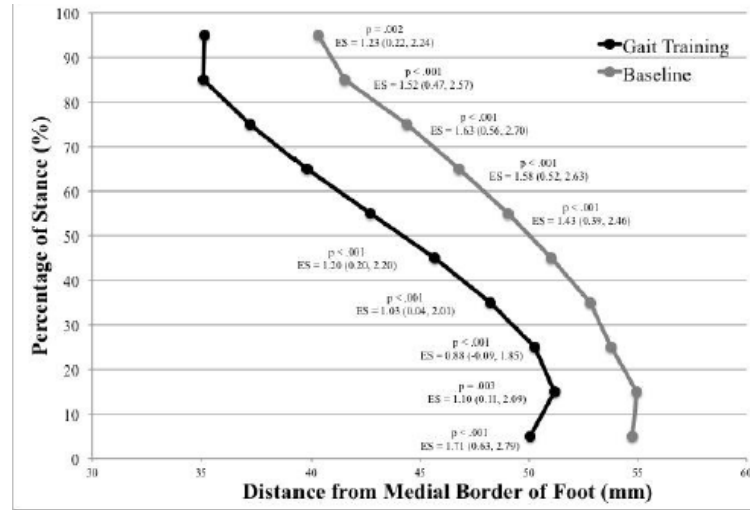


LT Force RT Force



LT Max pressure RT Max pressure





Proprioceptive deficits

What is Proprioceptive acuity?



Scand J Med Sci Sports 2002; 12: 329-336
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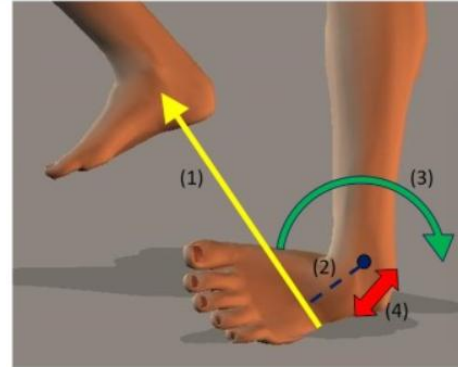
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 JOURNAL OF MEDICINE & SCIENCE
 IN SPORTS

Inversion injury biomechanics in functional ankle instability: a cadaver study of simulated gait

Journal of Athletic Training 2002; 37(4): 381-385
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 www.nata.org/jat

Factors Contributing to Chronic Ankle Instability: Kinesthesia and Joint Position Sense

Lars Konradsen



SPORTS BIOMECHANICS
 2022, VOL. 21, NO. 4, 359-379
<https://doi.org/10.1080/14763141.2022.2035801>

 Routledge
 Taylor & Francis Group

 OPEN ACCESS  Check for updates

What have we learnt from quantitative case reports of acute lateral ankle sprains injuries and episodes of 'giving-way' of the ankle joint, and what shall we further investigate?

Filip Gertz Lyssdal^{a,b}, Yuehang Wang^c, Eamonn Delahunt^{d,e}, Dominic Gehring^f,
 Kyle B. Kosik^g, Tron Krosshaug^h, Yumeng Liⁱ, Kam-Ming Mok^{j,k}, Kati Pasanen^{l,m},
 Alexandria Remusⁿ, Masafumi Terada^o and Daniel T. P. Fong^c

*“An inability to accurately **sense the position** of the ankle joint before initial contact is likely to result in a position that **predisposes the ankle to move into supination** rather than pronation during the loading response.”*

“an **incorrect foot position** at touchdown is the **highest risk factor** for lateral LAS”

JPS flexion plantaire/dorsale



JPS Inversion/éversion



En charge



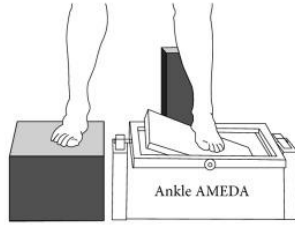
Joint position tests and Sense of force tests+++



(a)



(b)



(c)

