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Saas-Fee, March 9th 2016

Ankle sprain

From acute to chronic

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How your document works for the curious minds

Click on references → opens relevant internet pages

PubMed *Van Mechelen W et al, BJSM 2015*

Or the complete pdf document will open if available

FREE

Images contain sometimes hyperlinks, explore your pdf to learn more…

Enjoy! Boris

Acknowledgments

Francois Fourchet, PT, PhD
(La Tour Sport Medicine)

Romain Terrier, PhD
(Univ Savoie Mont-Blanc)

Académie de la cheville
e - learning de perfectionnement

A few numbers

30’000 ankle sprains in USA per day (11 mio per year)

Only 50% of sprains are unreported/treated

10’000 USD average cost of long term cost for ankle instability

Most frequent traumatic injury in sports (25%)

MSK injury that most frequently reccurs

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Selection Criteria for Patients With Chronic Ankle Instability in Controlled Research: A Position Statement of the International Ankle Consortium

Phillip A. Gribble, PhD, ATC, FNATA*; Eamonn Delahunt, PhD, BSc†;

- At least one significant ankle sprain (>12 mths ago)
- At least 1 interrupted day of desired physical activity
- **Giving way** (2 episodes in past 6 mths) and/or **Recurrence** (=2 or more) and/or **feeling of instability**
- Questionnaire **Ankle Instability Instrument (AII)** (YES to at least 5 questions, including number 1.)
- Functional limitation: **Foot and Ankle Ability Measure (FAAM)** ADL scale <90%, Sport scale <80%

Gribble PA et al, JAT 2014 FREE

Epidemiology of CAI after recurrence

- 25% in team sports (volleyball, football, basketball)
- 50% in ballet dancers
- 70% in first year

70-80% of ankle arthritic changes are post-traumatic and will appear before other joints degenerate

Arthritis

26 yrs from severe sprain to arthritis

10 to 40% of CAI lead to early arthritis

Why reccurrence / CAI can happen

1. Unreported, not treated (probably 50%)
2. Insufficiently rehabilitated (inadequate, too easy)
3. Neuromuscular and proprioceptive deficits (intrinsic)

RTP after lateral ankle sprain

27	**Functional performance testing** should be a component of the RTP decision making. Several tests (eg, single-legged hop for distance, Star Excursion Balance Test [SEBT]) may be used to help determine the patient's ability to RTP. Before the patient returns to sport-specific tasks, the injured limb's functional performance should measure **at least 80% of the uninjured limb**.	B
28	Athletes with a history of previous ankle sprains should wear **prophylactic ankle supports** in the form of ankle taping or bracing for all practices and games. Both lace-up and semirigid ankle braces and traditional ankle taping are effective in reducing the rate of recurrent ankle sprains in athletes.	B
26	The **patient's perception of function** should be included in any return-to-play (RTP) decision making. Several instruments (eg, Lower Limb Task Questionnaire and Cumberland Ankle Instability Tool [CAIT]) may be used to help identify the patient's perception of function and aid in the RTP decision process.	C

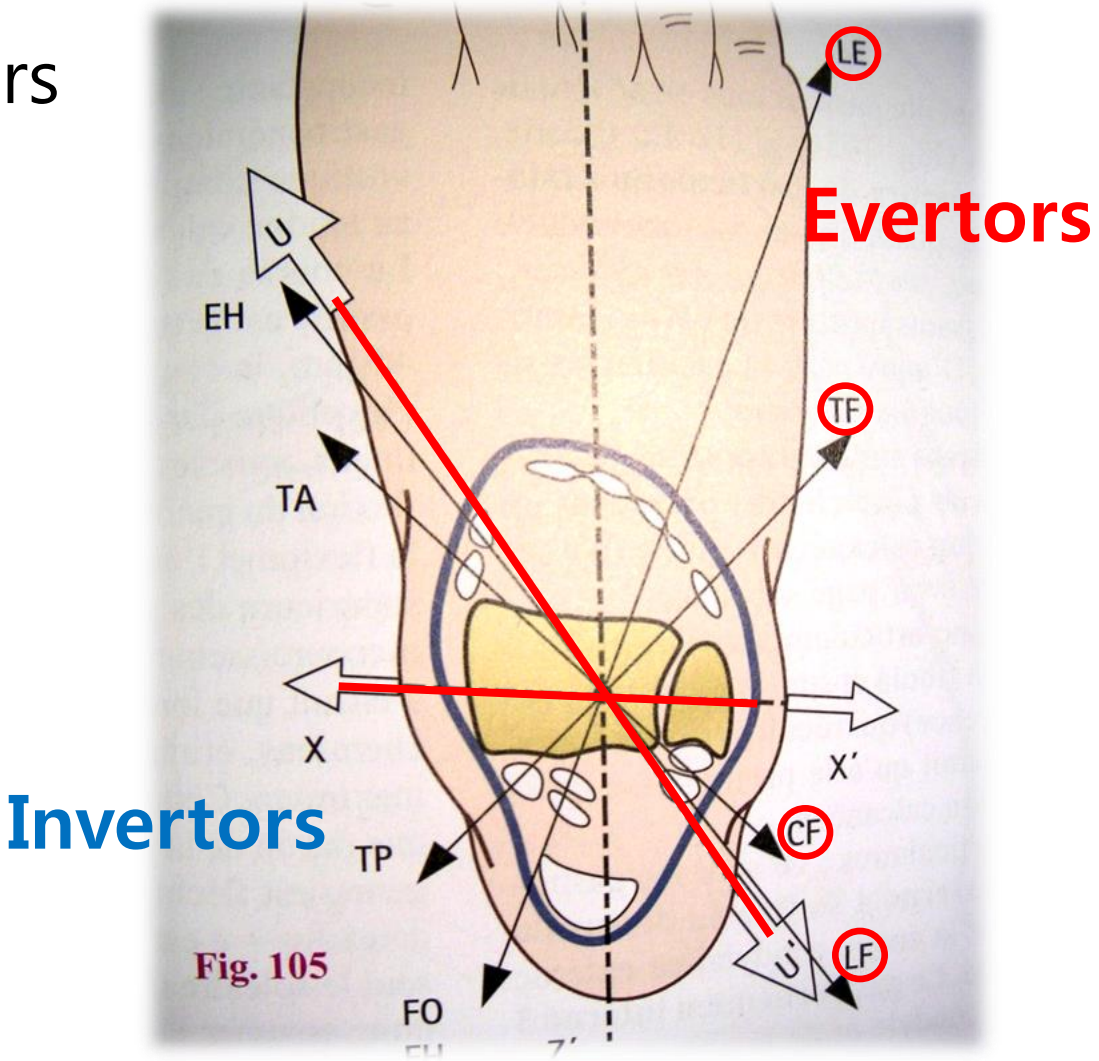
Evidence level A-C

Kaminski TW et al, JAT 2013 FREE

Programmed insufficiency

Inversion was useful to our ancestors

We have less evertor power than invertor pull



Sensori-motor rehabilitation

Manual Therapy 17 (2012) 285–291

Contents lists available at SciVerse ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Review article

Effectiveness of proprioceptive exercises for ankle ligament injury in adults: A systematic literature and meta-analysis☆

K. Postle [a,*], D. Pak [b], T.O. Smith [a]

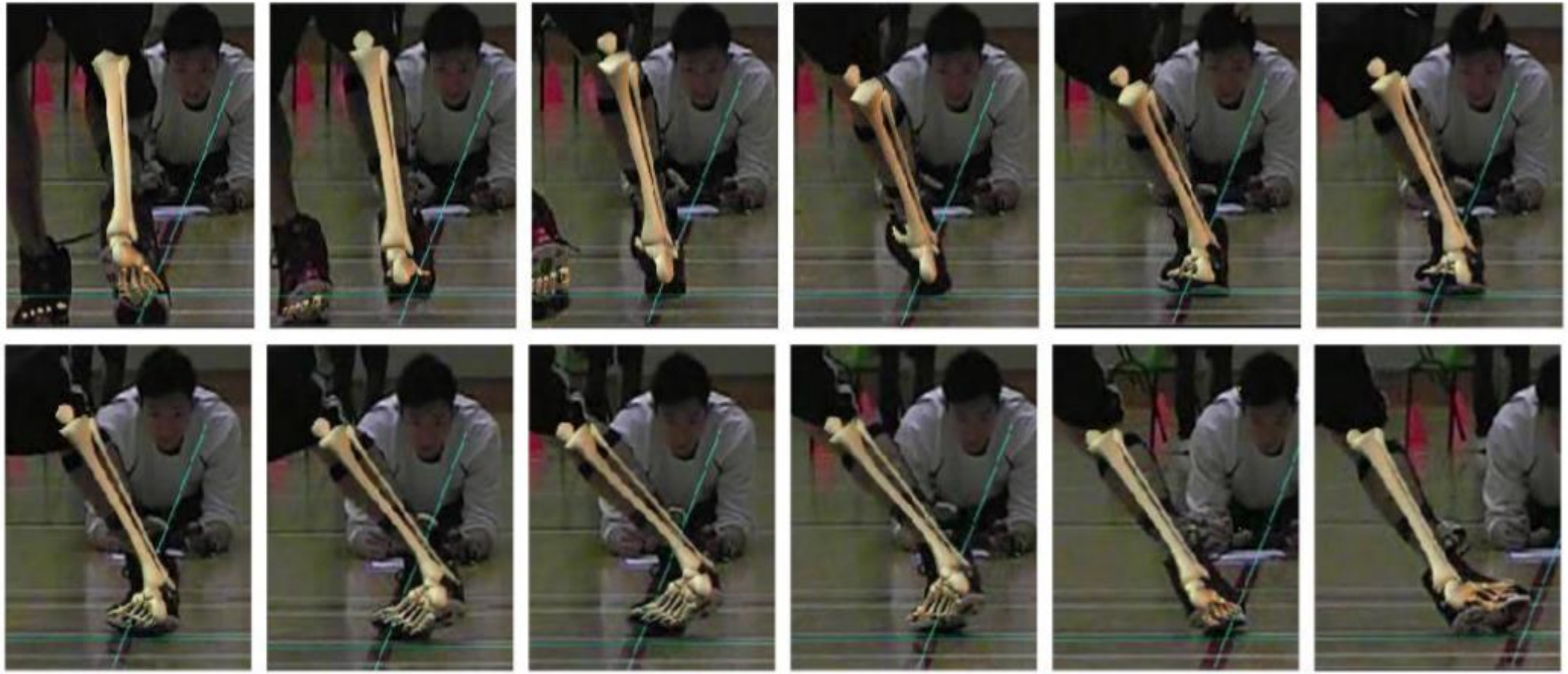
[a] School of Allied Health Professions, Faculty of Medicine and Health Science, University of East Anglia, Queen's Building, Norwich NR4 7TJ, UK
[b] Norwich Medical School, Faculty of Medicine and Health Science, University of East Anglia, Norwich NR4 7TJ, UK

Objective : prevent/ heal Chronic Ankle Instability (CAI)

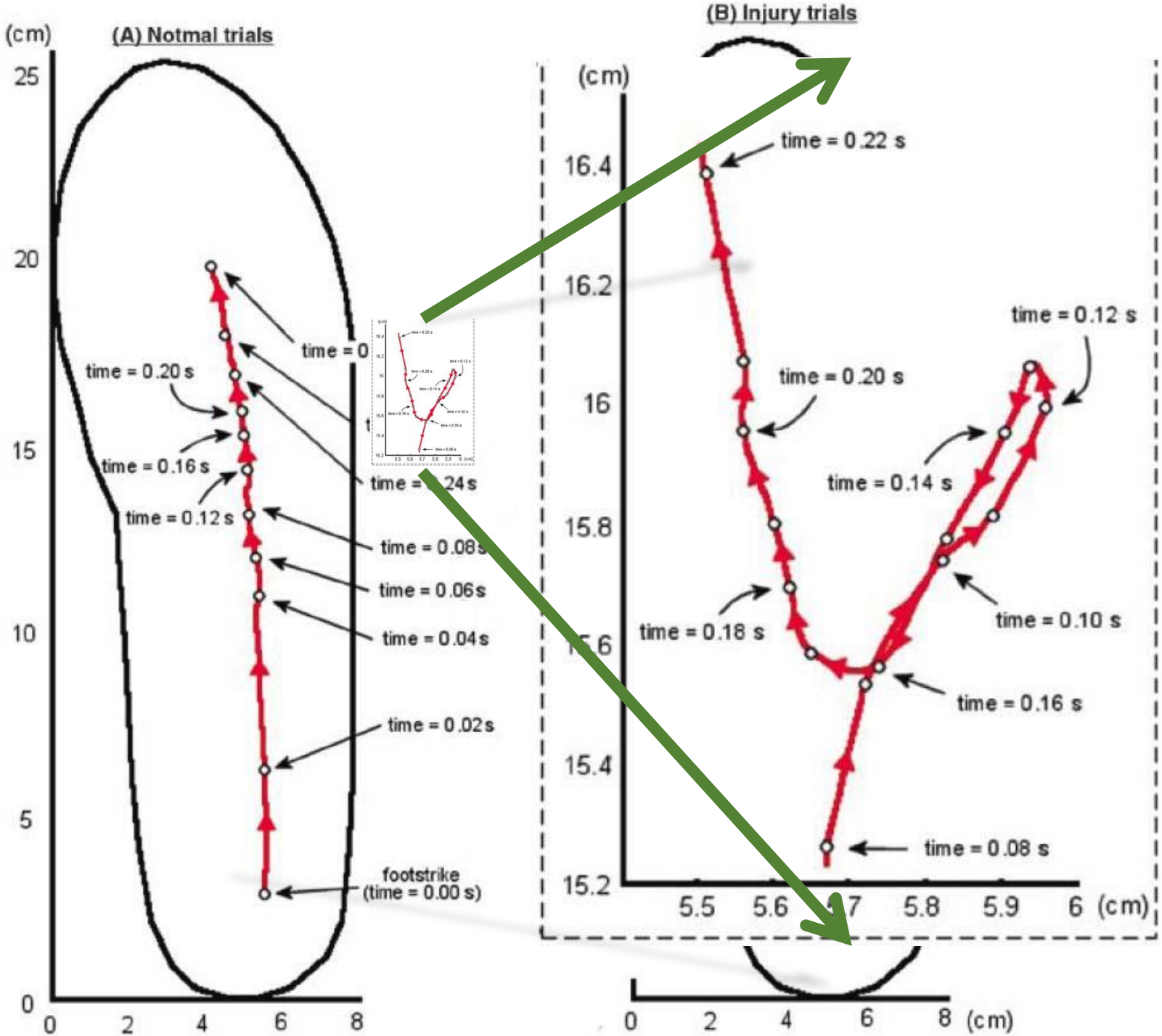
The results indicated that **there is no statistically significant difference in recurrent injury** with the addition of proprioceptive exercises during rehabilitation of patients following ankle ligament injury.

It did however **improve subjective instability** and **functional outcomes**

Ankle sprain 3D kinematics



Fong D et al, AJSM 2009 FREE

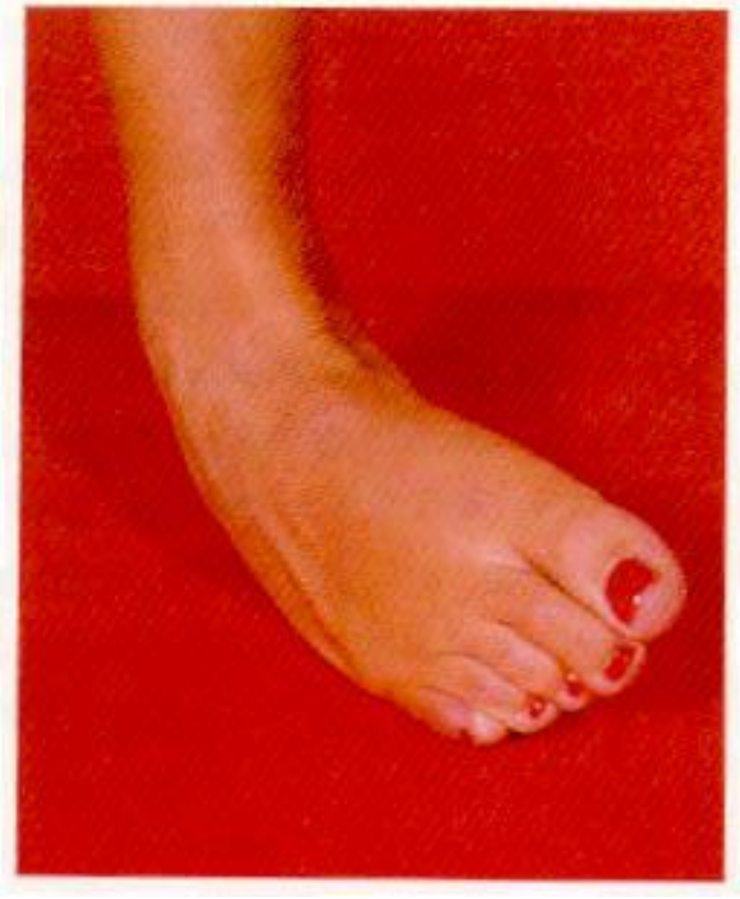

(A) Notmal trials
(cm)
25
20
15
10
5
0
0
2
4
6
8
time = 0.20 s
time = 0.16 s
time = 0.12 s
time = 0.08 s
time = 0.06 s
time = 0.04 s
time = 0.02 s
footstrike
(time = 0.00 s)
(B) Injury trials
(cm)
16.4
16.2
16
15.8
15.6
15.4
15.2
5.5
5.6
5.8
5.9
6
(cm)
time = 0.22 s
time = 0.12 s
time = 0.20 s
time = 0.14 s
time = 0.18 s
time = 0.10 s
time = 0.16 s
time = 0.08 s
0
2
4
6
8
(cm)

Too late…

Not enough time for peroneal muscles to contract

Usual mechanical reaction time = 80 ms

→ **too late**



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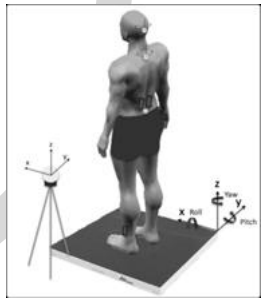
Evertor weakness

Proprioceptive deficit

Altered dynamic neuromuscular activity



Limited dorsiflexion

Other muscular weakness

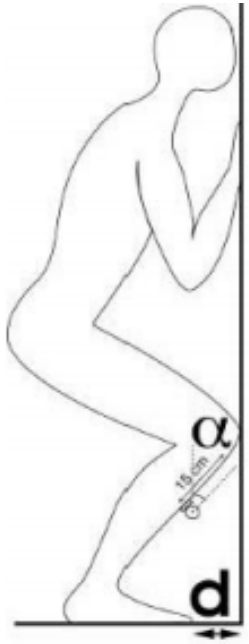
Insufficient postural control

Dorsiflexion

Dorsiflexion

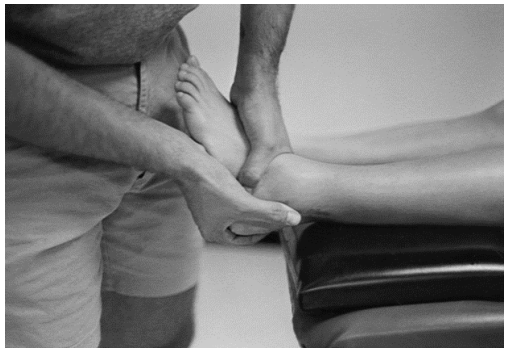
We know that DF deficits are present in CAI and can lead to recurrence, pain and functional deficits.

Can be improved by mobilization



NORMS OR NOMINAL VALUES: ADULT KNEE TO WALL TEST

TIGHT	NORMAL	HYPERMOBILE
<6cm	10-12cm	>12cm



Hoch MC et al, J Sci Med Sport 2012;15(6):574-9

Hoch MC et al, J Orthop Res 2012;30(11):798-804

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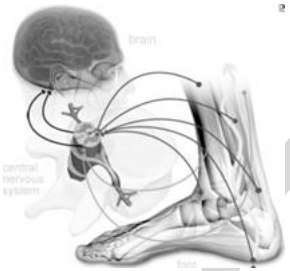
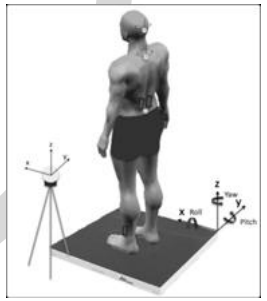
Evertor weakness

Proprioceptive deficit



Altered dynamic neuromuscular activity

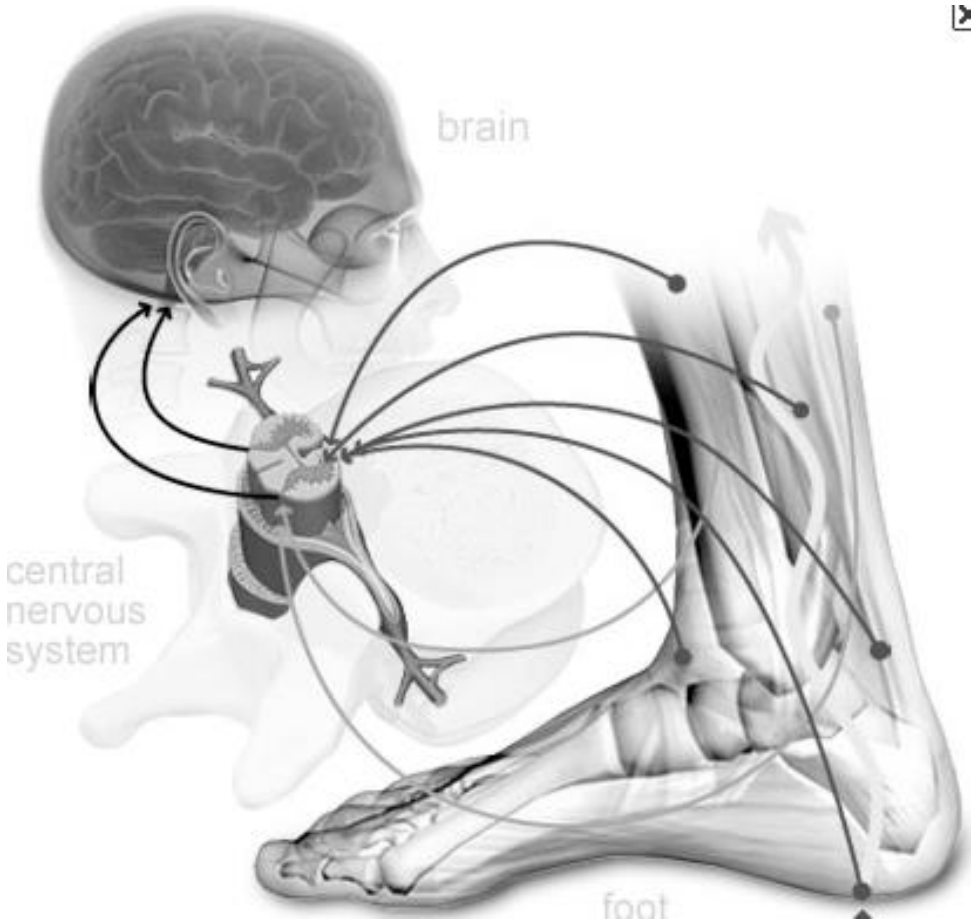


Limited dorsiflexion

Other muscular weakness

Insufficient postural control

Proprioceptive deficits



Background

Freeman (1965) described functional instability and attributed it to proprioceptive deficits.

After 48h of joint immobilization → cortical reorganization (sensori-motor mapping).

Fortuna M et al, PLOS one 2013

After 14 days immobilization → sensorimotor cortex thickness is reduced (altered brain plasticity).

Langer N et al, Neurology 2012;78:182

Proprioception

Proprioception = one's ability to integrate sensory signals from various mechanoreceptors → determine body position and movements in space.

Overall proprioception scores are significantly predictive of sport performance level.

Ankle proprioception is the one most strongly correlated in many weight-bearing sports.

Proprioception exercises, really?

Eur J Appl Physiol (2012) 112:1577–1585
DOI 10.1007/s00421-011-2124-8

ORIGINAL ARTICLE

Ankle proprioception is not targeted by exercises on an unstable surface

Henri Kiers · Simon Brumagne · Jaap van Dieën · Philip van der Wees · Luc Vanhees

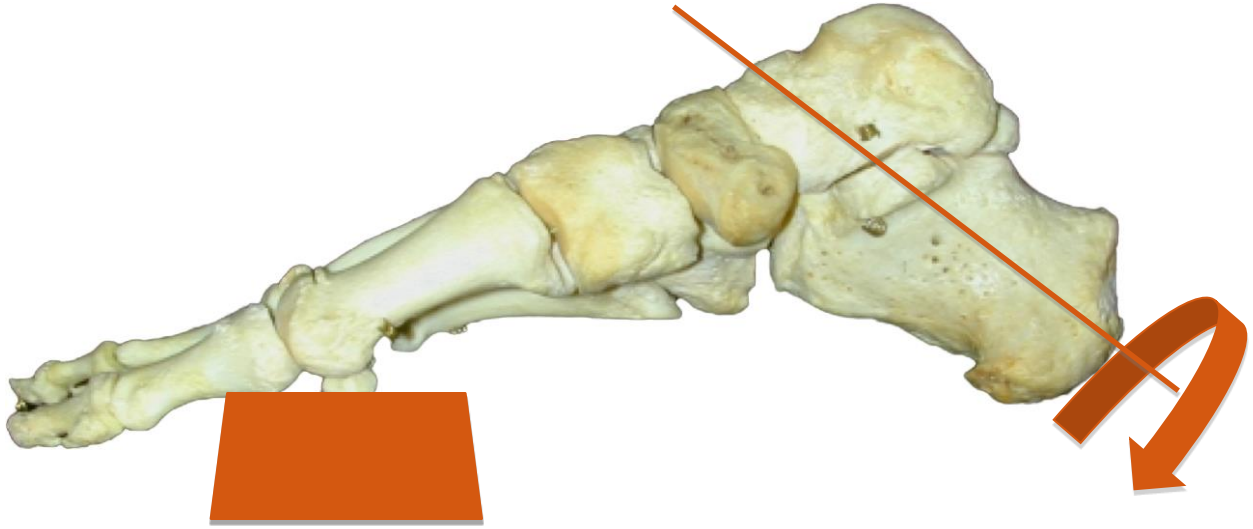
Exercises on unstable surfaces **do not challenge** peripheral ankle proprioception.

However they do help in rehabilitation.

Kiers H et al, EJAP 2012;112:1577

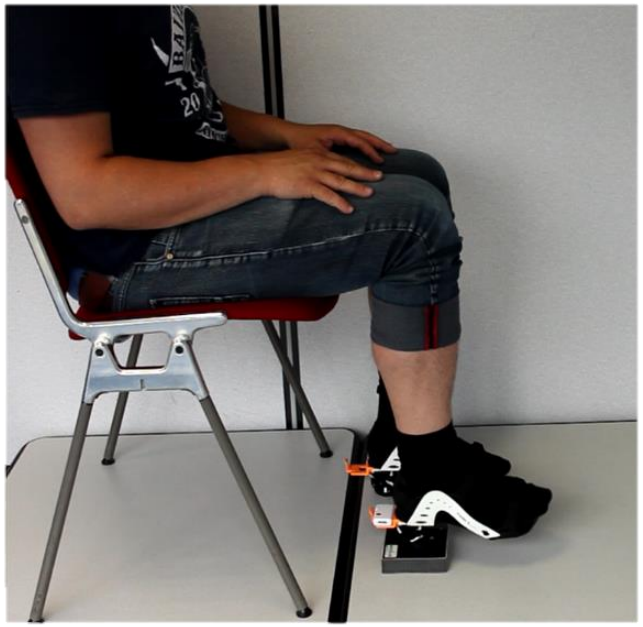
Stimulate ankle proprioception

By creating specific destabilizing conditions, peripheral ankle proprioception can be targeted. Ankle eversors play a major role.



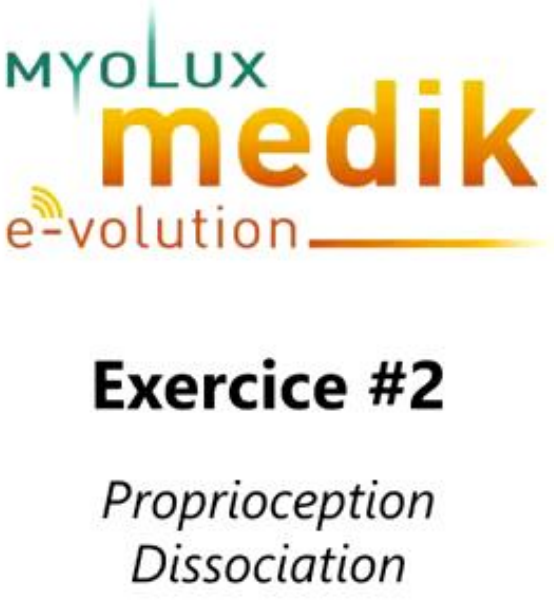
Posterior ankle (henke axis) destabilization

1. Joint position - repositionning



Patient reaches the green dot by moving his ankle along Henke (inv/eversion) axis. Then reproduces with eyes closed

2. Rearfoot dissociation



Patient mobilises rearfoot (subtalar joint) in isolation

3. Functional proprioception

Patient balances (eyes open, then closed), keeping motion in predefined range.

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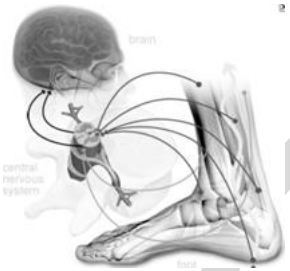
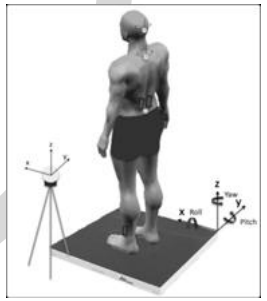
Evertor weakness

Proprioceptive deficit



Altered dynamic neuromuscular activity



Limited dorsiflexion

Other muscular weakness

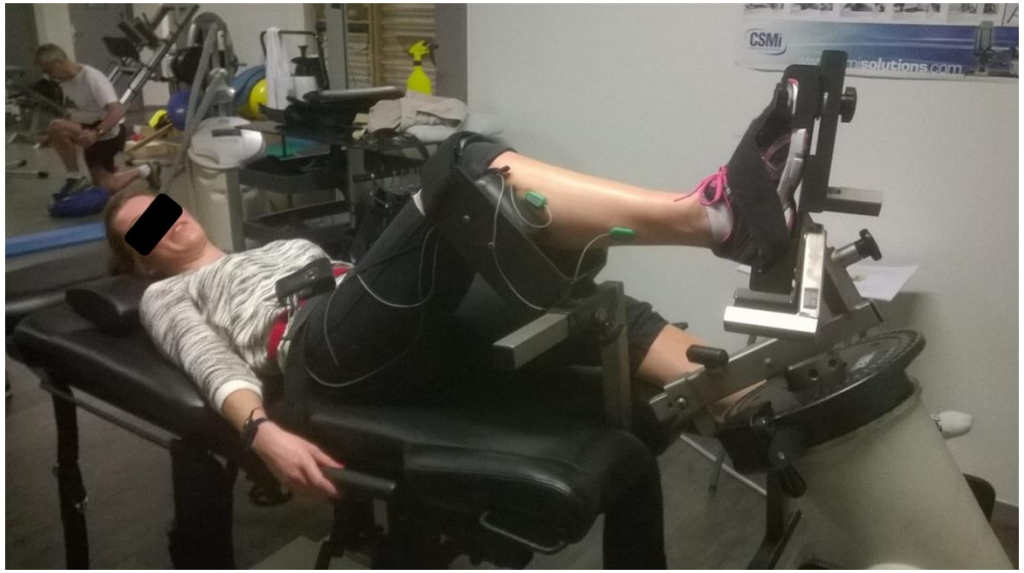
Insufficient postural control

Strength/weakness of evertors

Strength/weakness of evertors

Gold standard in literature is
isokinetic

Expensive, time-consuming, and in open kinetic chain = non-specific



Strength of evertors

Manual testing ist not reliable and not sensitive enough

Dire need for an assessment tool
- quick
- reproductible
- specific
- assesses eccentric strength

Evertor specific weight-bearing challenge

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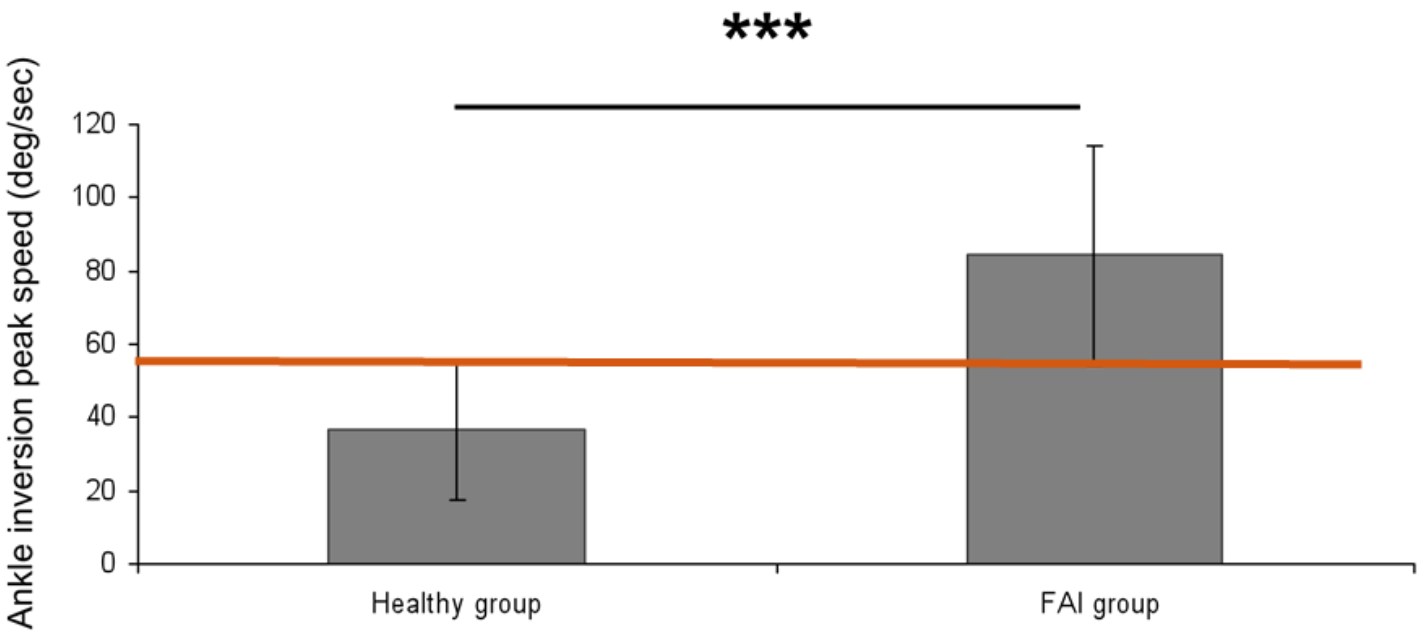
Impaired control of weight bearing ankle inversion in subjects with chronic ankle instability

R. Terrier [a,b,*], K. Rose-Dulcina [b], B. Toschi [b], N. Forestier [b]

Patients with CAI perform worse than healthy subjects

Cut-off seems to be at ~60 degrees/sec peak inversion speed



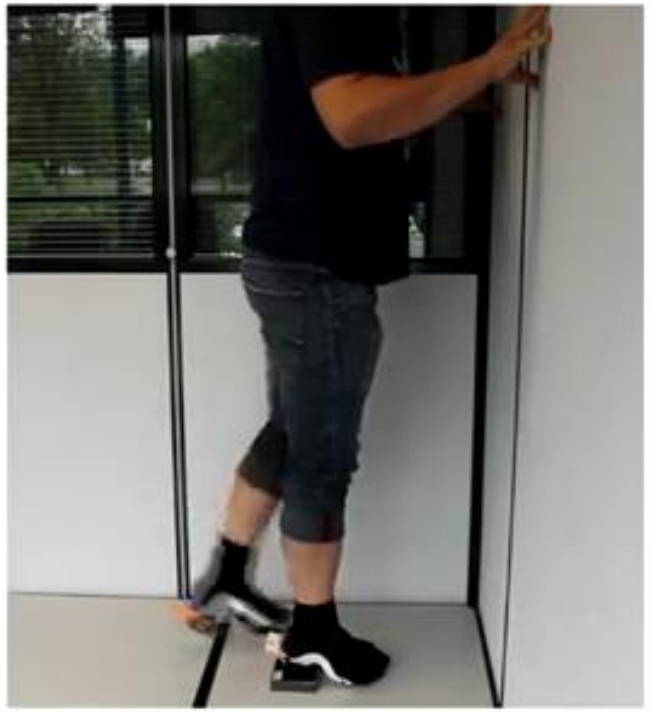
Terrier R et al, Clin Biomechanics 2014;29:439

Patient case

Eccentric control

Eccentric failure

4. Eccentric strengthening



Patient controls inversion = eccentric evertors strengthening

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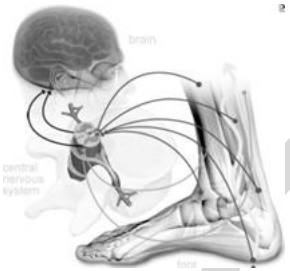
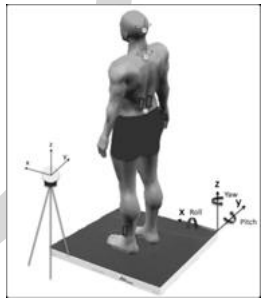
Evertor weakness

Proprioceptive deficit



Altered dynamic neuromuscular activity



Limited dorsiflexion

Other muscular weakness

Insufficient postural control

Altered dynamic neuromuscular activity

Pre-activation (anticipation)

Important mechanism in joint/muscle protection and important for performing subsequent task optimally.

Walking < Running < landing

Peroneal muscles activate (EMG signals) 80 ms **before** ground contact (= electro-mechanical delay) in healthy subjects, but not in CAI patients.

Suda EY et al, J Electromyogr Kinesiol 2009;19:e84-93

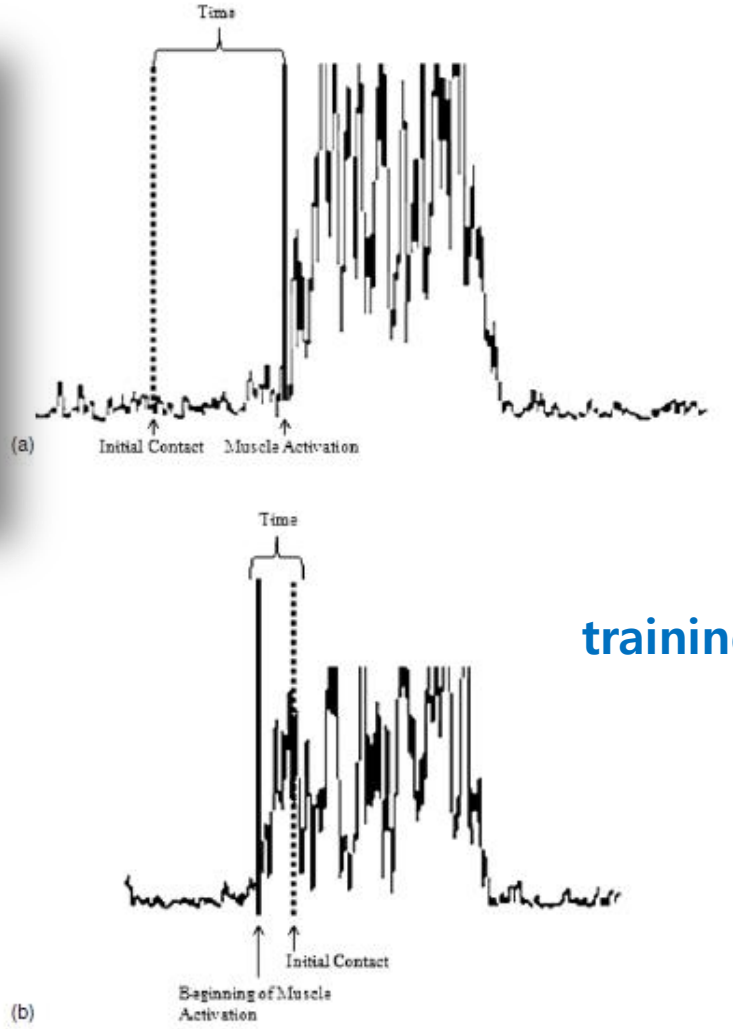
Retraining feed forward mechanisms

Journal of Sport Rehabilitation, 2014, 23, 134-144
http://dx.doi.org/10.1123/JSR.2013-0021

JOURNAL OF
SPORT REHABILITATION
www.JSR-Journal.com
ORIGINAL RESEARCH REPORT

Lower-Extremity Electromyography Measures During Walking With Ankle-Destabilization Devices

Luke Donovan, Joseph M. Hart, and Jay Hertel



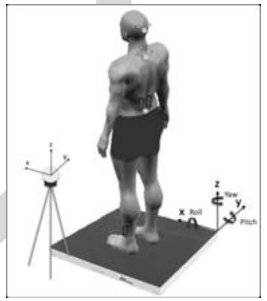
training

Walking with ankle destabilization device enhances total **peroneal** and **GL** activation AND results in **PRE-activation** as well → enhances stability upon landing

Evertor weakness

Proprioceptive deficit

Altered dynamic neuromuscular activity

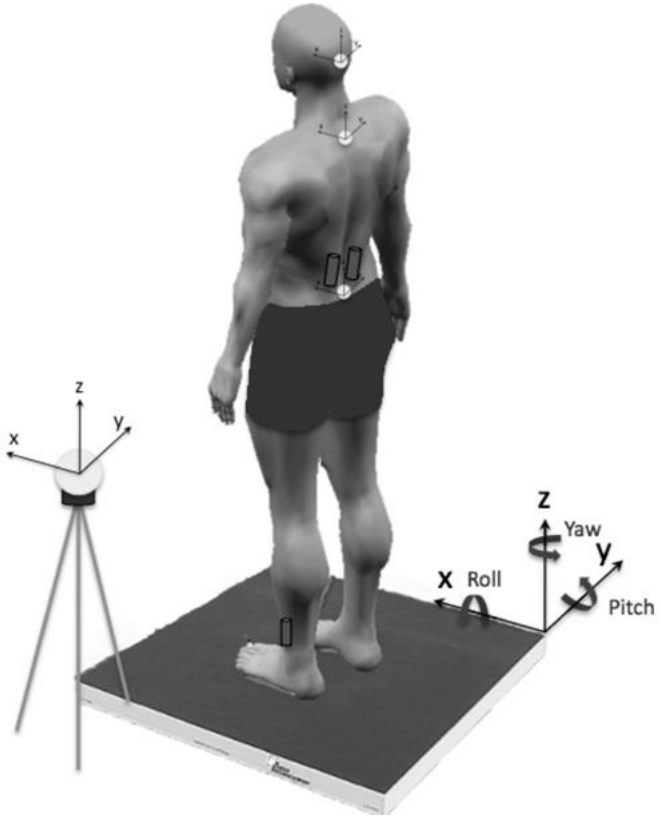


Limited dorsiflexion

Other muscular weakness

Insufficient postural control

Postural control alteration



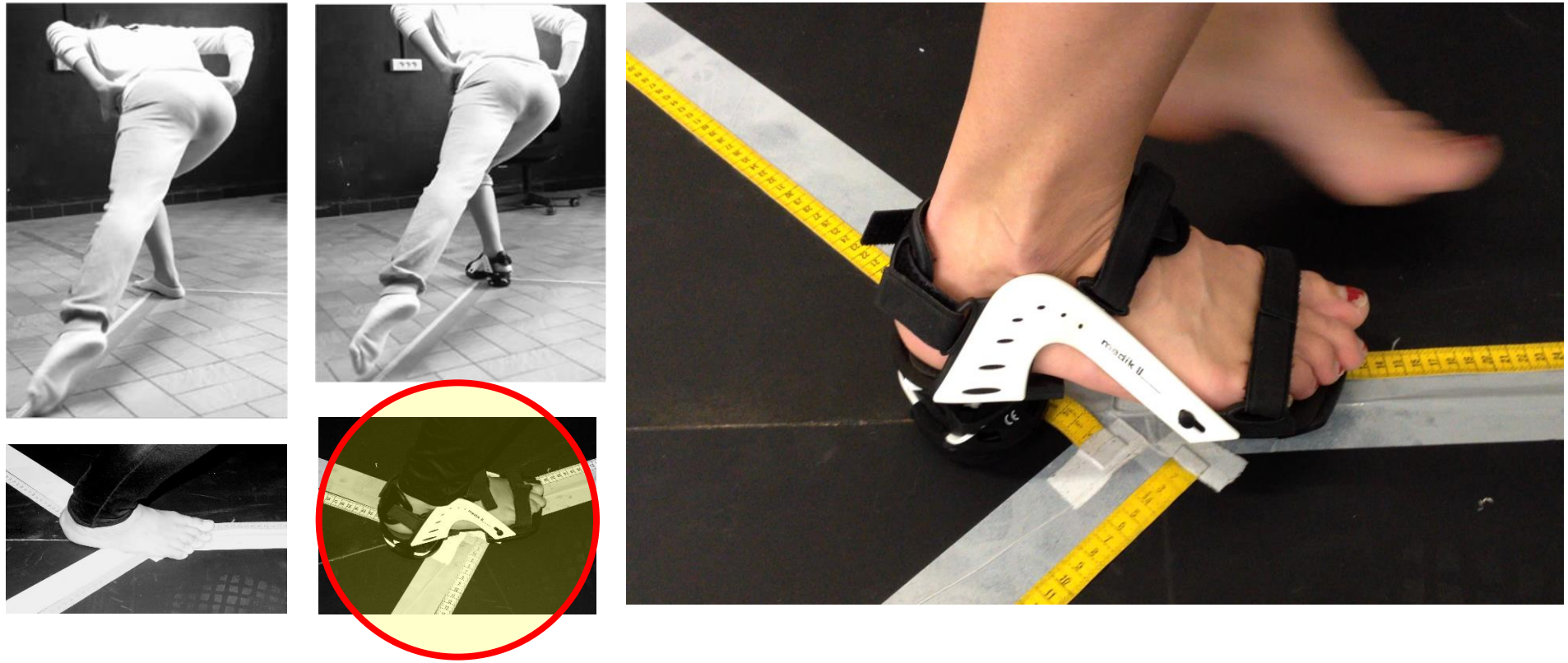
Y balance test

Gold standard measure in the literature (measure distance reached)

Gribble PA et al, JAT 2012;47:339-57 FREE

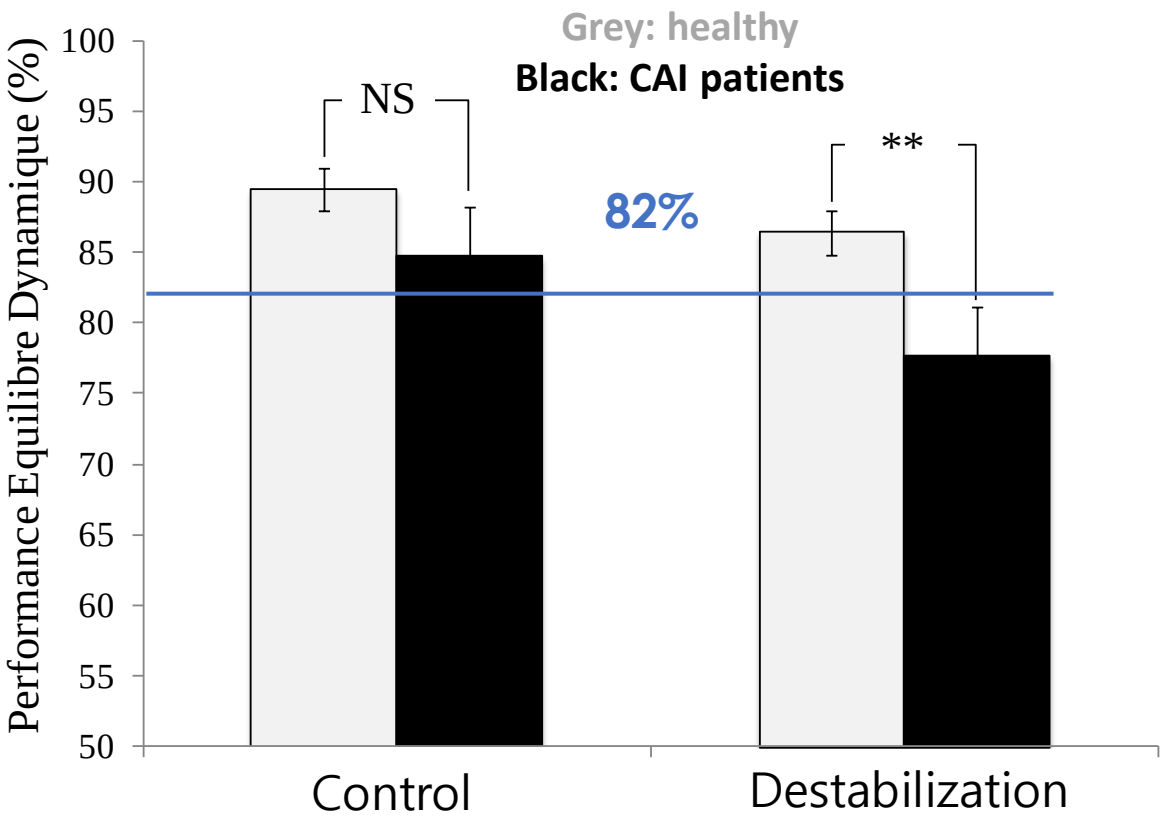
Improve ankle specificity of Y-test

Use destabilization device to perform the test



Test performance is increased
=better discrimination

Cut-off = 82% of lower limb length



Terrier R et al, personal communication

Other postural exercises
(≠ankle proprioception!)

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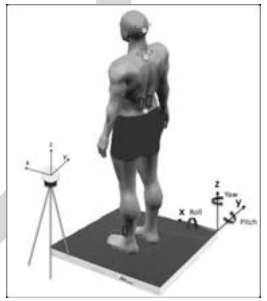
Evertor weakness

Proprioceptive deficit

Altered dynamic neuromuscular activity

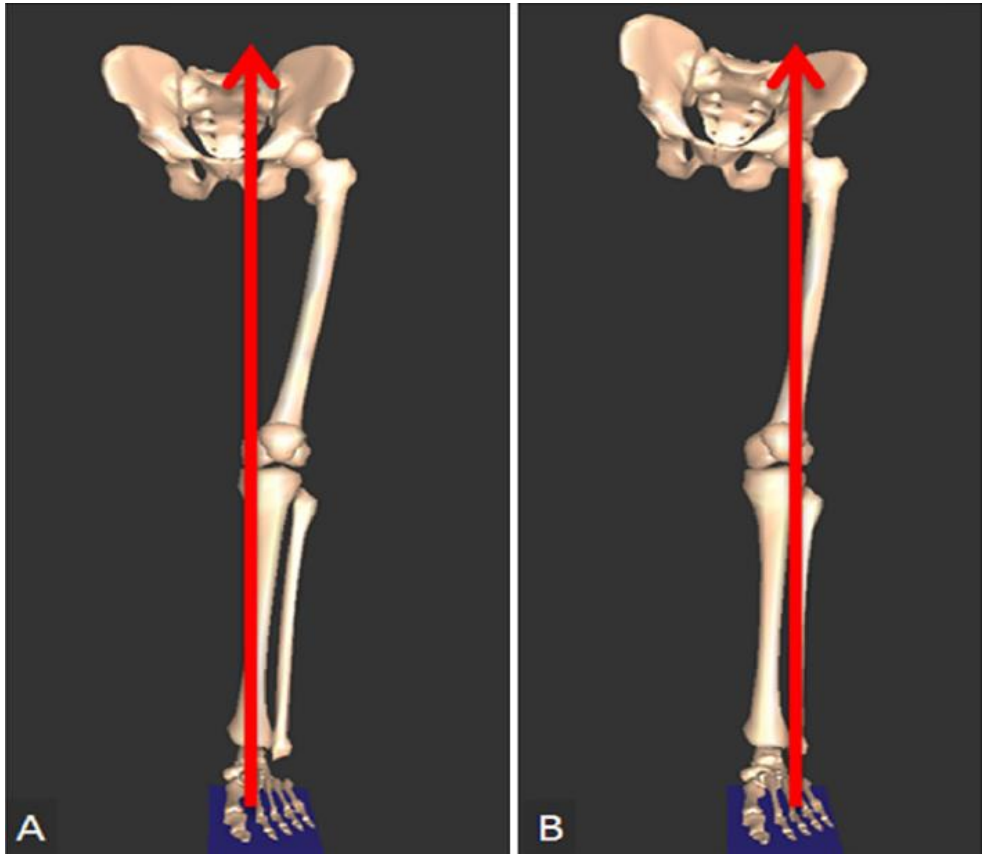


Limited dorsiflexion

Other muscular weakness

Insufficient postural control

Other muscular deficits



Hip abductors weakness

Weaker individuals

1. Have larger med-lat COP displacement
2. utilize more ankle strategy to stabilize in balance tasks

Lee SP & Powers CM, Gait & Posture 2014;39:933-8

Handheld dynamometry (HHD)

Hanche
ABDUCTION

Hanche
ROTATION
EXTERNE
assis

Summary for CAI evaluation

Questionnaires: AII, FAAM, CAIT

Postural: SEBT or Y-test, with specific conditions

Propriocetion: joint repositionning, dissociation, functional movement

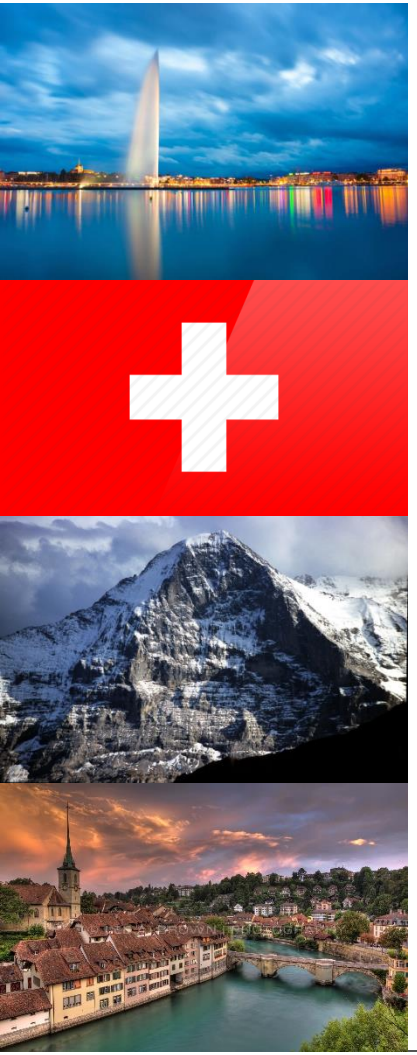
Evertor muscles: eversion control or isokinetic

Dorsiflexion: angle measurement and Knee-to-wall

Hip abductor muscles: hand-held dynamometer

No good RTP criteria for ankle CAI

Return to Competition Score - RTCS



- Proprioceptive tests (repositioning, dissociation fore/rearfoot, functional performance)
- Evertors strength (isokinetic or Myolux)
- Dorsiflexion measurement
- Hops (1, 3), drop jump
- Postural tests – SEBT, Y
- Clinical: swelling, ROM
- Hip abductors strength
- Questionnaire: AII, FAAM

Thank you

T - @DrSportSante
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