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Sports Medicine Secrets: Ankle and Foot Strength, Mobility, and Coordination Deficits

CSM 2019- Washington DC

KAISER PERMANENTE. thrive

Clinical Pattern Recognition

AZUSA PACIFIC UNIVERSITY

- Andrew Morcos PT, DPT, SCS, OCS, DNSP, ATC, CSCS, FAAOMPT
- Marshall LeMoine, PT, DPT, OCS, SCS, CSCS, FAAOMPT
- Michael Wong, PT, DPT, OCS, FAAOMPT
- Stephania Bell, PT, OCS, CSCS

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Clinical Pattern Recognition

KAISER PERMANENTE. thrive

AZUSA PACIFIC UNIVERSITY

ESPN

Washington DC APTA CSM 2019

DISCLOSURE

Michael Wong, PT, DPT, OCS, FAAOMPT

Marshall LeMoine, PT, DPT, OCS, SCS, CSCS, FAAOMPT

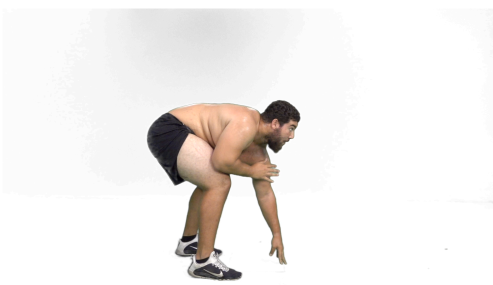
Medical Web App Developer

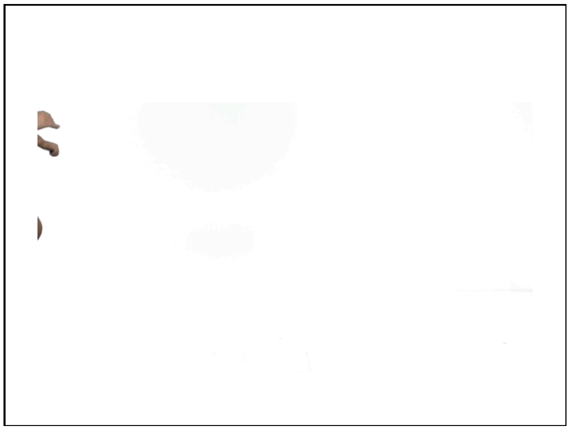
PHYSIO•U

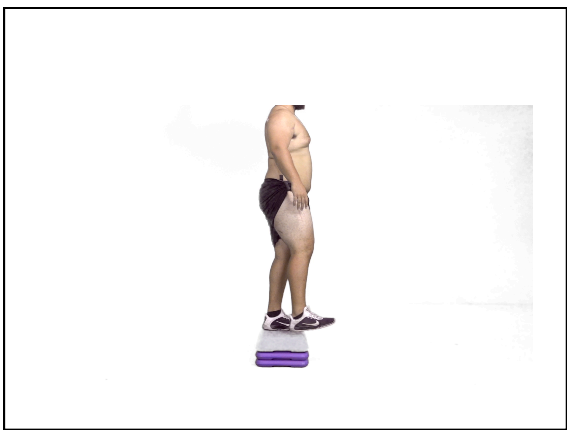
Clinical Pattern Recognition

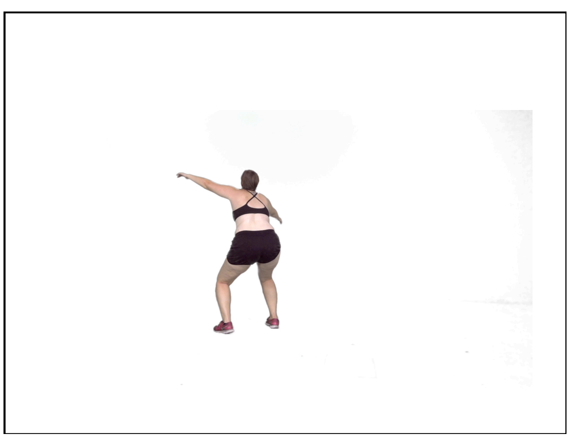
Course Objectives

- Overview of the research for the most common movement impairments related to athletic injury
- Visual movement analysis to drive objective examination of movement system impairments
- Targeted exercise prescription and manual therapy for movement system impairments
- Utilize video analysis for lower quarter movement dysfunction
- Integration into high level athletes



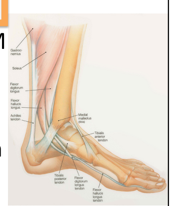






Ankle and Foot Impairments

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits



Insufficient Dorsiflexion

The Effect of Reduced Ankle Dorsiflexion on Lower Extremity Mechanics during Landing: A systematic review of the literature

Article · June 2015

DOI: 10.1016/j.jsams.2015.06.006

May 2017 Volume 20, Issue 5, Pages 451–458

Journal of Science and Medicine in Sport

Journal of Athletic Training 2011;46(1):5–10

www.nata.org/jat

original research

Ankle-Dorsiflexion Range of Motion and Landing Biomechanics

Chun-Man Fong, LAT, ATC*; J. Troy Blackburn, PhD, ATC†; Mar

[RESEARCH REPORT]

SUSAN M. SIGWARD, PT, PhD, ATC[1] • SUSUMU OTA, PT, MS[2] • CHRISTOPHER M. POWERS, PT, PhD[3]

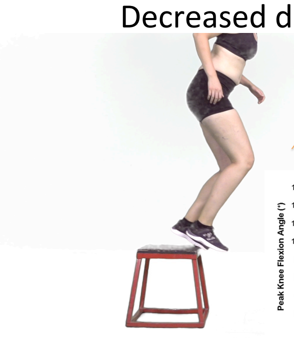
Predictors of Frontal Plane Knee Excursion During a Drop Land in Young Female Soccer Players

Published in final edited form as:
Knee Surg Sports Traumatol Arthrosc. 2015 December ; 23(12): 3550–3555. doi:10.1007/s00167-014-3222-z.

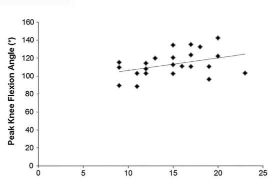
The Association of Dorsiflexion Flexibility on Landing Mechanics during a Drop Vertical Jump

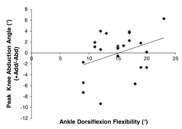
Philip Malloy, PT[1], Carolyn Meinerz[2], Christopher Geiser, PT, ATC[3,4], and Kristof Kipp, PhD[4]

Decreased dorsiflexion

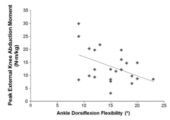


Less peak knee flexion Angles during landing





Decreased dorsiflexion ROM

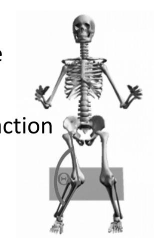


Greater peak knee Abduction angles

Greater peak knee abduction moments

Sigward et al. found < ankle dorsiflexion range of motion associated with greater frontal plane knee excursion in female soccer players during a drop jump task

- Landing mechanisms altered with restricted DF
  - Decreased knee flexion angle
  - Increased Knee valgus angle
  - Increased vertical ground reaction forces



- Greater dorsiflexion ROM
  - Smaller GRF
  - Greater knee-flexion displacement
- Decreased shock absorption, and increased compensation in other planes

Journal of Sport Rehabilitation, 2012, 21, 144-150

Effect of Limiting Ankle-Dorsiflexion Range of Motion on Lower Extremity Kinematics and Muscle-Activation Patterns During a Squat

Elisabeth Macrum, David Robert Bell,
Michelle Boling, Michael Lewek, and Darin Padua

- Wedge group
  - decreased DF and knee flexion excursion
  - increased knee valgus angle and medial knee displacement

Journal of Athletic Training 2014;49(6):723–732
doi: 10.4085/1062-6050-49.3.29

www.natajournals.org

original research

Altered Knee and Ankle Kinematics During Squatting in Those With Limited Weight-Bearing–Lunge Ankle-Dorsiflexion Range of Motion

Karli E. Dill, MA, ATC*; Rebecca L. Begalle, PhD, ATC†; Barnett S. Frank, MA, LAT, ATC*; Steven M. Zinder, PhD, ATC‡; Darin A. Padua, PhD, ATC*

*Department of Exercise and Sport Science, University of North Carolina at Chapel Hill; †School of Kinesiology and Recreation, Illinois State University, Normal; ‡Department of Orthopaedics and Sports Medicine, Morsani College of Medicine, University of South Fl

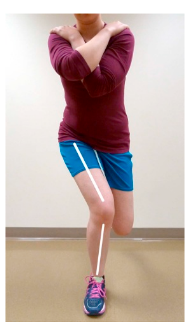
Normal: > 15 deg
Impaired: < 5 deg

Figure 1. Nonweight-bearing ankle-dorsiflexion range-of-motion assessment.

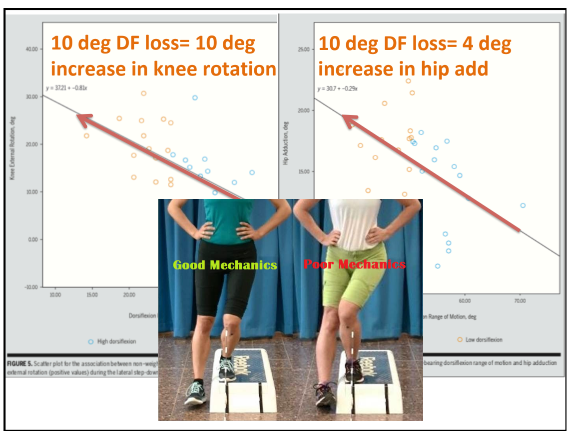
Figure 2. Weight-bearing lunge test.

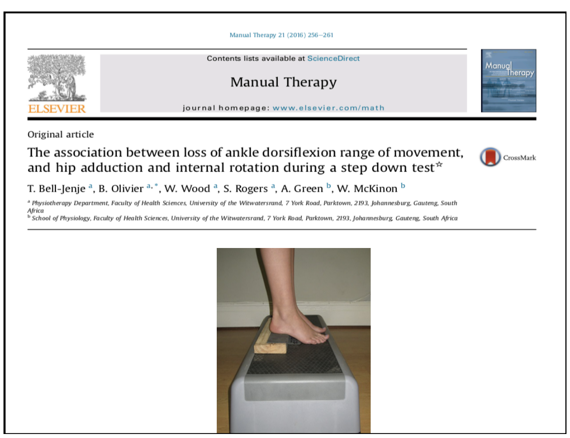
Limited DF in weight-bearing lunge

- Over head squat
  - 8 deg less DF displacement
  - 15 deg less knee flexion
- SL squat
  - 6 deg less DF
  - 12 deg less knee flexion
  - 6 deg more knee valgus
- Faults see in restricted WB lunge group only

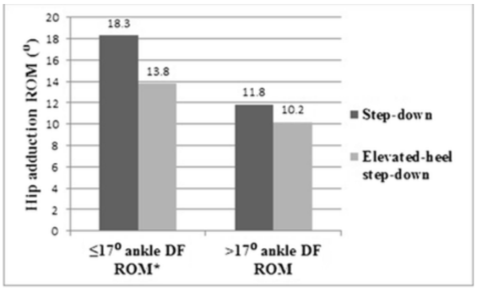



RESEARCH REPORT
ALON RABIN, DPT, PhD[1] • SIGAL PORTNOY, PhD[2,3] • ZVI KOZOL, PT, PhD[1]
The Association of Ankle Dorsiflexion Range of Motion With Hip and Knee Kinematics During the Lateral Step-down Test
Altered lower extremity movement patterns have been previously associated with several knee disorders, including anterior cruciate ligament rupture, patellofemoral pain, patellar tendinopathy, and iliotibial band syndrome.[5,6,8,12,16,22,24,25,36] These movement patterns are typically characterized by decreased sagittal plane hip and knee motion, along with excessive hip or knee
strain on several ligamentous,[16] tendinous,[25,37] and articular[17,18] structures, possibly leading to tissue failure, pain, and disability. Therefore, recognizing modifiable factors associated with such an altered movement pattern would, be important to applying the proper preven-
FIGURE 3. Non-weight-bearing dorsiflexion measurement.
FIGURE 2. Weight-bearing dorsiflexion measurement.


10 deg DF loss= 10 deg increase in knee rotation
10 deg DF loss= 4 deg increase in hip add
Good Mechanics
Poor Mechanics


Manual Therapy 21 (2016) 256–261
Contents lists available at ScienceDirect
Manual Therapy
journal homepage: www.elsevier.com/math
ELSEVIER
Original article
The association between loss of ankle dorsiflexion range of movement, and hip adduction and internal rotation during a step down test☆
T. Bell-Jenje [a], B. Olivier [a,*], W. Wood [a], S. Rogers [a], A. Green [b], W. McKinon [b]
[a] Physiotherapy Department, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown, 2193, Johannesburg, Gauteng, South Africa
[b] School of Physiology, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown, 2193, Johannesburg, Gauteng, South Africa

With increased DF = decreased hip adduction



ig. 4. Hip adduction ROM during step-down (SD) and elevated-heel step-down EHSD) in females with reduced (≤17°) and females with optimal (>17°) ankle DF ROM *p = 0.008).

The Knee 21 (2014) 669–675

Contents lists available at ScienceDirect

The Knee

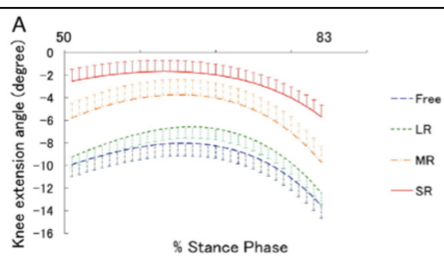
Acute influence of restricted ankle dorsiflexion angle on knee joint mechanics during gait

S. Ota [a,*], M. Ueda [b], K. Aimoto [c], Y. Suzuki [c], S.M. Sigward [d]

[a] Department of Rehabilitation and Care, Seijoh University, Tokai 476-8588, Japan
[b] Division of Rehabilitation, Syutaikai Hospital, Yokkaichi 510-0823, Japan
[c] Department of Advanced Medicine, National Center for Geriatrics and Gerontology, Obu 474-8511, Japan
[d] Division of Biokinesiology & Physical Therapy, University of Southern California, Los Angeles 90089-9006, CA, United Sta

- 4 braced conditions
  - Unrestricted
  - light (10 deg DF)
  - moderate (0)
  - severe restriction (-10 deg)

Fig. 1. Custom-made ankle brace (Matsumoto P & O Co., Ltd., Aichi, Japan). The brace was used to limit the ankle DF using a dial lock joint to allow plantar flexion. Ankle markers were attached on the skin.



- Decreased DF = Decreased knee flexion
  - Knee hyper-extension often seen in in those restricted to < 5 deg
- Decreased DF = Increased valgus angle

IJSPT

ORIGINAL RESEARCH

RELIABILITY OF THREE MEASURES OF ANKLE DORSIFLEXION RANGE OF MOTION

Megan M. Konor[1]
Sam Morton, MS, CSCS, USAW[1]
Joan M. Eckerson, PhD, FACSM, FNSCA, CSCS[1]
Terry L. Grindstaff, PhD, PT, ATC, SCS, CSCS[1]

Approx 40 deg WB DF is normal

Table 1. *Weight-Bearing Lunge Dorsiflexion Range of Motion Measurement Averages.*

Test	Mean±SD
Tape Measure	9.5 ± 3.1 cm
Digital Inclinometer	38.8 ± 5.2°
Goniometer	43.2 ± 5.8°

Averages were determined using data from each side (right and left) during trial 1

Manual Therapy 20 (2015) 524–532
Contents lists available at ScienceDirect
Manual Therapy
journal homepage: www.elsevier.com/math

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]
[a] Health Service Research, College of Heath Sciences, Old Dominion University, Health Sciences Annex, RM 105, Norfolk, VA 23539, USA
[b] School of Physical Therapy and Athletic Training, College of Heath Sciences, Old Dominion University, Norfolk, VA, USA

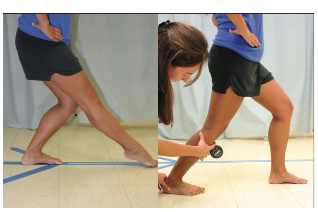
- A total of 12 studies met the eligibility criteria
- Good inter and intra clinician reliability

IJSPT

ORIGINAL RESEARCH

ANKLE DORSIFLEXION RANGE OF MOTION INFLUENCES DYNAMIC BALANCE IN INDIVIDUALS WITH CHRONIC ANKLE INSTABILITY

Curtis R. Basnett, PT, DPT, ATC[1]
Michael J. Hanish, PT, DPT[1]
Todd J. Wheeler, PT, DPT[1]
Daniel J. Miriovsky, PT, DPT, ATC[1]
Erin L. Danielson, PT, DPT[1]
J.B. Barr, PT, DPT, OCS[1]
Terry L. Grindstaff, PT, PhD, ATC, SCS, CSCS[1]



- > 4 cm difference in anterior reach = 2.5x risk LE injury
- Limited DF correlated to limited anterior reach

Gait & Posture 41 (2015) 912–916

Contents lists available at ScienceDirect

Gait & Posture

journal homepage: www.elsevier.com/locate/gaitpost

Contributing factors to Star Excursion Balance Test performance in individuals with chronic ankle instability

Michael L. Gabriner[a], Megan N. Houston[b,*], Jessica L. Kirby[c], Mat

[a] The Steadman Clinic, 181 W. Meadow Dr. Suite 400, Vail, CO 81657, United States

DF ROM 31% of variance in anterior reach direction

Gait & Posture

Volume 40, Issue 1, May 2014, Page

The influence of ankle dorsiflexion and self-reported patient outcomes on dynamic postural control in participants with chronic ankle instability

Masafumi Terada[a], Matthew S. Harkey[b], Ashley M. Wells[a], Brian G. Pietrosimone[b], Phillip A. Gribble[a]

Patellar Tendinopathy and Lack of Dorsiflexion

- Volleyball players (Mallares et al., 06)
- Basketball players (Backman at al., 11)
  - 5 deg less DF at baseline
  - < 36 deg DF
  - Increased risk up to 29% of developing Patellar tendinitis within a year
  - Less shock attenuation
- History of 2 or more ankle sprains related to less DF

Strength Around the Hip and Flexibility of Soft Tissues in Individuals With and Without Patellofemoral Pain Syndrome

Sara R. Piva, PT, PhD, OCS, FAAOMPT[1]
Edward A. Goodnite, PT, MS[2]
John D. Childs, PT, PhD, MBA, OCS, FAAOMPT[3]

Gastroc length: 7 vs 18 deg
Soleus length: 15 vs 22 deg

TABLE 2. Muscle strength and muscle length measurements of the 30 … subjects of the matched control group, 95% CI, *t* value, and *P* value of paired *t* test statistics between groups.

Measurements	PFPS (mean ± SD)	Control (mean ± SD)	95% CI	*t* Value	*P* Value
Hip external rotation strength (% body mass)	22.0 ± 4.3	23.0 ± 4.7	–3.4; 0.8	–1.3	.218
Hip abduction strength (% body mass)	18.0 ± 7.3	21.0 ± 4.0	–6.0; –0.7	–2.6	.016
Iliotibial band/tensor fascia lata complex length (deg)	11.7 ± 10.2	15.0 ± 5.6	–7.2; 0.69	–1.7	.102
Quadriceps length (deg)	134.0 ± 11.3	145.4 ± 10.6	–16.5; –6.3	–4.6	<.001*
Hamstring length (deg)	79.1 ± 11.5	88.6 ± 10.5	–15.1; –4.1	–3.6	<.001*
Gastrocnemius length (deg)	7.4 ± 6.0	17.6 ± 5.2	–12.9; –7.5	–7.7	<.001*
Soleus length (deg)	14.8 ± 4.8	21.7 ± 4.8	–9.0; –4.8	–6.6	<.001*

* Significant at $\alpha \leq .007$

TABLE 3. Stepwise discriminant analysis between the groups with and without patellofemoral pain syndrome.

Step	Variables Included	Wilks λ	F	*P* Value
1	Gastrocnemius length	0.548	47.1	<.001
2	Hip abduction strength	0.508	27.2	<.001
3	Soleus length	0.471	20.6	<.001

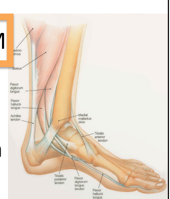
- *Arndt et al (04), Witvrouw et al (00), Stergio et al (99)*
  - Limited DF (soft tissue restrictions) associated with excessive pronation and tibial IR
  - Lead to increased femoral rotation increasing Patellar femoral stresses.

Limited dorsiflexion recap

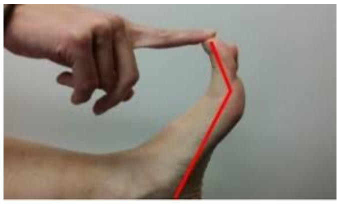
- Decreased DF with functional tests:
  - Increased ground reaction forces, knee adduction and valgus angles, knee abduct moments, and knee rotation
  - Decreased knee flexion angle
- Norm: 40 deg
  - WB lunge better than table
- Chronic ankle instability
  - SEBT ant reach 4 cm, 31% variance
- Patellar tendinopathy
  - 5 deg difference or < 36 deg, 30% greater risk
- PFPS
  - limited gastroc flexibility (11 deg)

Ankle and Foot Impairments

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits



Insufficient Big Toe Extension Mobility



J Am Podiatr Med Assoc. 2009 May-Jun;99(3):236-43.

Functional hallux limitus: a review.

Foot Ankle Int. 2016 May;37(5):537-41. doi: 10.1177/1071100715621508. Epub 2015 Dec 9.

Accurate Measurement of First Metatarsophalangeal Range of Motion in Patients With Hallux Rigidus

J Am Podiatr Med Assoc. 2006 Sep-Oct;96(5):428-36.

Effects of hallux limitus on plantar foot pressure and foot kinematics during walking.

Van Gheluwe

ELSEVIER

Journal of Biomechanics 39 (2006) 2005–2013

JOURNAL OF BIOMECHANICS

www.elsevier.com/locate/jbiomech
www.JBiomech.com

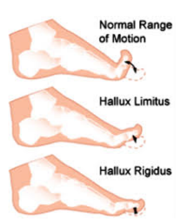
Differences in muscle function during walking and running at the same speed

Kotaro Sasaki, Richard R. Neptune*

Department of Mechanical Engineering, University of Texas at Austin, Austin, TX 78712, USA

Accepted 15 June 2005

- Structural hallux rigidus vs Functional hallux limitus
- Normal PROM great toe: 100 deg
  - Gait: Approximately 60 degrees needed
- With limited range:
  - Earlier and greater peak plantar pressure under hallux
  - Increased FHL activity, further restricting extension



Contents lists available at SciVerse ScienceDirect
Gait & Posture
journal homepage: www.elsevier.com/locate/gaitpost

Foot kinematics and loading of professional athletes in American football-specific tasks

Patrick O. Riley [a,*], Richard W. Kent [a], Tracy A. Dierks [b], W. Brent Lievers [a], Rebecca E. Frimenko [a], Jeff R. Crandall [a]
[a] Center for Applied Biomechanics, University of Virginia, Charlottesville, VA, USA
[b] Department of Physical Therapy, Indiana University, Indianapolis, IN, USA

- Analyzed walking, running, cutting and jumping

Events	Talocural RoM (°)	Subtalar RoM (°)	MTP RoM (°)		
Walk	**25.2** (**3.1**) *25.2/25.8/24.7*	**15.0** (**4.9**) *10.6/15.9/18.4*	**53.7** (**6.0**) *54.5/50.0/56.6*		
Run	**40.7** (**6.6**) *36.0/41.3/44.8*	**14.2** (**5.1**) *10.5/13.9/18.1*	**59.5** (**16.1**) *52.5/51.3/72.2*	*50.8/49.4/39.2*	*238/238/*
Reverse	**44.4** (**7.7**) *42.0/43.4/47.8*	**25.6** (**8.9**) *25.0/20.9/24.3*	**23.4** (**8.4**) *28.6/17.3/24.2*	**−102.1** (**11.0**) *−103.4/−98.1/−104.7*	**192** (**37**) *179/193.*
Cut right leg	**49.7** (**7.8**) *45.2/50.9/53.0*	**21.6** (**10.2**) *20.6/20.1/24.3*	**38.1** (**10.2**) *31.6/46.7/36.0*		
Cut left leg	**45.5** (**8.9**) *39.9/48.7/47.9*	**27.0** (**11.1**) *30.1/17.3/33.7*	**31.6** (**10.2**) *28.1/39.2/27.4*		
Start AP	**41.3** (**13.2**) *46.0/32.8/45.2*	**22.4** (**10.2**) *26.7/15.1/25.4*	**37.3** (**14.7**) *39.8/41.7/29.0*		
Start lateral	**48.4** (**7.2**) *44.8/47.2/53.2*	**24.1** (**8.7**) *30.7/16.8/25.0*	**18.5** (**6.2**) *17.5/21.9/16.5*		
Jump	**67.4** (**6.4**) *69.4/64.2/68.8*	**16.8** (**5.9**) *15.4/13.7/21.4*	**34.1** (**7.1**) *35.3/31.3/35.5*		
Plant AP	**33.2** (**9.3**) *37.6/26.5/38.1*	**14.9** (**6.6**) *12.2/11.0/19.6*	**28.7** (**6.2**) *25.5/28.1/31.7*		
Plant lateral	**29.8** (**8.5**) *24.6/30.8/33.2*	**13.2** (**8.4**) *9.1/14.1/15.8*	**21.1** (**10.4**) *23.0/17.0/23.2*		
Jump landing	**49.4** (**9.7**) *51.7/46.6/49.9*	**13.1** (**7.5**) *14.5/13.8/11.2*	**39.3** (**11.1**) *34.7/38.8/44.1*	**71.8** (**41.4**) *58.8/103.3/53.6*	**339**(**124**) *301/457/*
Group median	*44.4*	*16.8*	*34.5*	*−14.6*	209
Class median	*47.8/42.0/43.4*	*21.4/15.4/15.1*	*34.3/31.6/33.3*	*−11.5/−16.9/−15.5*	*200/203/*
p value	**0.43/0.69/0.90**	**0.26/0.74/0.21**	**0.95/0.79/1.00**	**0.95/0.74/0.95**	**0.55/0.74**

Walk- 54 deg
Run- 60 deg

PeerJ. 2017 Dec 18;5:e4103. doi: 10.7717/peerj.4103. eCollection 2017.

Three-dimensional variations in the lower limb caused by the windlass mechanism.

Manfredi-Márquez MJ[#1], Tovaruela-Carrión N[1], Távara-Vidalón P[1], Domínguez-Maldonado G[1], Fernández-Seguín LM[2], Ramos-Ortega J[#1].

- Average of 47 deg for windlass mechanism
  - *Similar to Nester et al. (2014), Halstead & Redmond (2006) and Nawoczenski, Baumhauer & Umberger (1999)*
- Important for mid foot and hind foot stabilization for push off
  - Delayed windlass mechanism associated with inversion at heel strike and a greater magnitude of rearfoot eversion

J Am Podiatr Med Assoc. 2014 Sep-Oct;104(5):468-72. doi: 10.7547/0003-0538-104.5.468.

An assessment of hallux limitus in university basketball players compared with noncompetitive individuals.

Trégouët P.

Basketball players: 21 deg limited verses controls

Accepted: 13 February 2017
DOI: 10.1111/sms.12862

ORIGINAL ARTICLE

WILEY

Muscle stiffness of posterior lower leg in runners with a history of medial tibial stress syndrome

J. Saeki[1,2] | M. Nakamura[3] | S. Nakao[1] | K. Fujita[4] | K. Yanase[1] | N. Ichihashi[1]

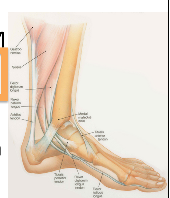
Runners with history of MTSS had increased stiffness in FHL

Insufficient Big Toe Extension Mobility Recap

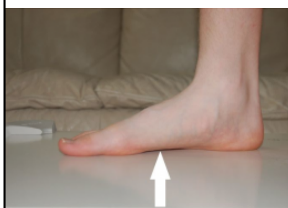
- Hallux limitus vs rigidus
- Norms:
  - PROM >100 deg, Gait and Running >60
- Increased peak plantar pressures
- Windlass mechanism at least 47 deg
  - Otherwise increased rearfoot eversion magnitude
- Common loss of mobility in basketball players
- Associated with increased stiffness in FHL
  - Medial tibial stress syndrome??

Ankle and Foot Impairments

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits



Excessive Pronation



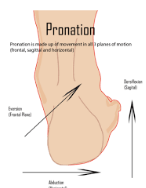
Gait & Posture 38 (2013) 363–372
Contents lists available at SciVerse ScienceDirect
Gait & Posture
journal homepage: www.elsevier.com/locate/gaitpost

Review

The relationship between foot posture and lower limb kinematics during walking: A systematic review

Andrew K. Buldt[a,b,*], George S. Murley[a,b], Paul Butterworth[a,b], Pazit Levinger[c], Hylton B. Menz[b], Karl B. Landorf[a,b]

- Planus foot posture associated with increased rearfoot eversion at stance phase of gait
- Most significant differences found after heel off

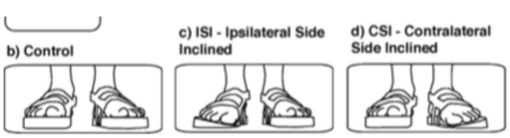


Gait & Posture 41 (2015) 395–401
Contents lists available at ScienceDirect
Gait & Posture
journal homepage: www.elsevier.com/locate/gaitpost

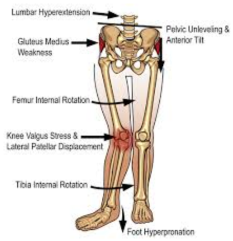
Increased unilateral foot pronation affects lower limbs and pelvic biomechanics during walking

Renan A. Resende[a,*], Kevin J. Deluzio[b], Renata N. Kirkwood[c], Elizabeth A. Hassan[b], Sérgio T. Fonseca[a]

- Effects of increased unilateral foot pronation on biomechanics of lower limb and pelvis during gait



- Increased foot pronation
  - increased tibial internal rotation angles
  - reduced knee and hip internal rotation moments
  - increased pelvic ipsilateral drop



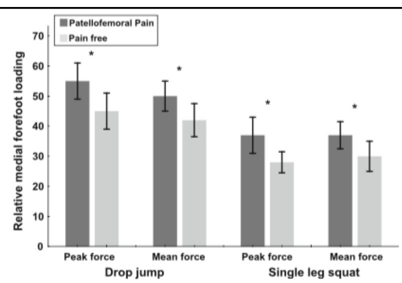
Knee Surg Sports Traumatol Arthrosc (2014) 22:2301–2307
DOI 10.1007/s00167-014-2943-3

KNEE

Increased medial foot loading during drop jump in subjects with patellofemoral pain

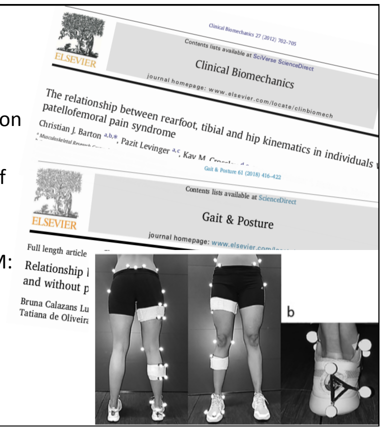
Michael S. Rathleff · Camilla Richter · Christoffer Brushøj · Jesper Bencke · Thomas Bandholm · Per Hölmich · Kristian Thorborg

igure 1. Drop jump sequence



- Greater medial orientated loading pattern of forefoot vs controls without PFPS
- PFPS:
  - 22% higher medial peak force in jump landing
  - 32% higher in SL squat

- PFPS:
  - Greater peak rearfoot eversion
  - Greater peak tibial IR: 16% of its variance
  - Greater hip adduction ROM: 33% of its variance

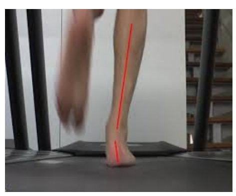


Biomechanical Factors Associated With Achilles Tendinopathy and Medial Tibial Stress Syndrome in Runners

James Becker,* PhD, Stanley James,† MD, Robert Wayner,‡ DPT, Louis Osternig,§ PhD, ATC, and Li-Shan Chou,§‖ PhD
Investigation performed at the Motion Analysis Laboratory, University of Oregon, Eugene, Oregon, USA

EVERSION:

- Excursion ?
- Velocity ?
- Duration ?



- No difference in total amount of eversion
- Greater rearfoot eversion at heel off (-6 vs 1 deg)
- Longer duration of eversion (86% vs 59% stance)

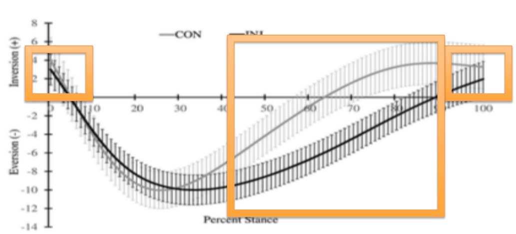


Figure 1. Mean inversion/eversion curves for the pooled

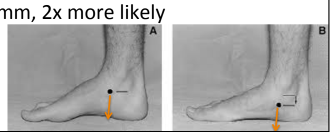
Open Access Journal of Sports Medicine
Dovepress
open access to scientific and medical research
Open Access Full Text Article

REVIEW

Risk factors associated with medial tibial stress syndrome in runners: a systematic review and meta-analysis

This article was published in the following Dove Press journal:
Open Access Journal of Sports Medicine
12 November 2013
Number of times this article has been viewed

- Systematic review and meta-anaylsis (21 studies)
- Medial Tibial Stress Syndrome
  - Greater Navicular drop one of the top predictors
  - Navicular dop > 10 mm, 2x more likely



[RESEARCH REPORT]

LUIS A. FEIGENBAUM, PT, DPT, SCS, ATC, LAT, CSCS[1] • KATHRYN E. ROACH, PT, PhD[2] • LEE D. KAPLAN, MD[3]
BRYSON LESNIAK, MD[3] • SEAN CUNNINGHAM, ATC, LAT[4]

The Association of Foot Arch Posture and Prior History of Shoulder or Elbow Surgery in Elite-Level Baseball Pitchers

- Longitudinal Arch Angle (typical 130-150)
- Pes Planus- < 130
- Pes Cavus- > 150

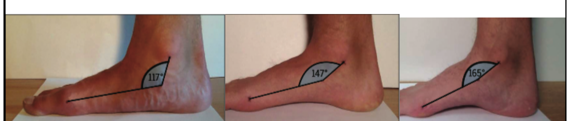


FIGURE 3. Pes planus foot arch posture as measured by the longitudinal arch angle. | Typical foot arch posture as measured by ...dinal arch angle. | ...es cavus foot arch posture as measured ...udinal arch angle.

- Stance foot
  - odds ratio for having pitching-arm surgery with either type of abnormal arch posture of the stance foot was 3.4x
  - <u>pes planus</u> posture was 3.7
  - pes cavus posture was 3.2
- Lunge Foot
  - either type of abnormal arch posture was 2.9x
  - <u>pes cavus</u> posture was 3.4
  - pes planus posture was 2.4

The Foot 34 (2018) 1–5

Contents lists available at ScienceDirect

The Foot

journal homepage: www.elsevier.com/locate/foot

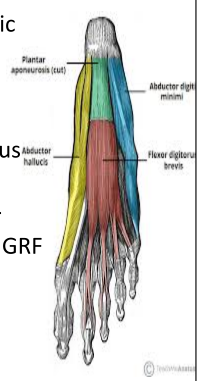
Original Article

The effect of additional activation of the plantar intrinsic foot muscles on foot dynamics during gait

Kazunori Okamura[a,*], Shusaku Kanai[b], Masaki Hasegawa[b], Akira Otsuka[c], Sadaaki Oki[b]

[a] Graduate School of Comprehensive Scientific Research, Prefectural University of Hiroshima, 1-1 Gakuen-cho, Mihara-shi, Hiroshima 723-0053, Japan
[b] Department of Physical Therapy, Faculty of Health and Welfare, Prefectural University of Hiroshima, 1-1 Gakuen-cho, Mihara-shi, Hiroshima 723-0053, Japan
[c] Hiroshima Cosmopolitan University, 3-2-1 Otsuka Higashi Asaminami-ku, Hiroshima-shi, Hiroshima 731-3166, Japan

- Electrical stimulation to intrinsic muscles from midstance to preswing
- Abductor Hallicus, Flexor Digitorum Brevis, and Quadratus Plantae
- Significant slowing of navicular drop and decreased in vertical GRF

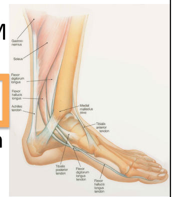


Excessive Pronation Recap

- Pes Planus associated with rear foot eversion
  - Largest differences seen at terminal stance to preswing
  - Increased tibial IR and reduced knee and hip IR moments
- PFPS: rearfoot eversion
  - 16% variance in tibial IR and 33% hip adduction in walking
  - Higher medial to lateral peak forces in jumping and SL squat
- Medial Tibial Stress Syndrome:
  - greater rearfoot eversion at heel off, and longer duration of eversion
  - Navicular drop > 10 mm= 2x greater risk
- Longitudinal arch angle: normal 130-150
  - Abnormal arch posture associated with increased risk for UE injury in pitchers.
- Electrical stimulation to plantar intrinsics slows down arch collapse and decreases vertical GRF

Ankle and Foot Impairments

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits



Excessive Supination

Pes Cavus

Gait & Posture 42 (2015) 42–48

Contents lists available at ScienceDirect

Gait & Posture

journal homepage: www.elsevier.com/locate/gaitpost

Foot posture is associated with kinematics of the foot during gait: A comparison of normal, planus and cavus feet

Andrew K. Buldt [a,b,*], Pazit Levinger [c], George S. Murley [a,b], Hylton B. Menz [b], Christopher J. Nester [d], Karl B. Landorf [a,b]

[a] Discipline of Podiatry, College of Science, Health and Engineering La Trobe University, Bundoora, VIC 3086, Australia
[b] Lower Extremity and Gait Studies Program, College of Science, Health and Engineering La Trobe University, Bundoora, VIC 3086, Australia
[c] Institute of Sport, Exercise & Active Living, College of Sport and Exercise Science Victoria University, Footscray, VIC 8001, Australia
[d] School of Health Sciences, University of Salford, UK

- Higher peak plantar pressure in lateral heel
- Decreased midfoot ROM at initial contact and midstance
  - Less deformation of medial longitudinal arch

Gait Posture. 2004 Jun;19(3):263-9.

High-arched runners exhibit increased leg stiffness compared to low-arched runners.

Williams DS 3rd[1], Davis IM, Scholz JP, Hamill J, Buchanan TS.

- Measured leg stiffness in high arched vs low arched runners
- Looked at ability of lower extremity to attenuate excessive forces generated during stance phase of running

- Pes cavus conditions
  - Decreased knee flexion excursion during stance
  - Increased vertical loading rates
  - Significantly earlier onset of vastus lateralis
  - **Higher leg stiffness**
  - **Decreased shock absoprtion**

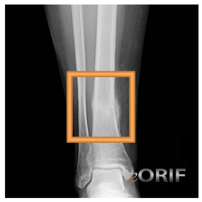
Medicine & Science in Sports & Exercise. 38(2):323-328, FEB 2006
DOI: 10.1249/01.mss.0000183477.75808.92, PMID: 16531902
Issn Print: 0195-9131
Publication Date: 2006/02/01

Print

Biomechanical Factors Associated with Tibial Stress Fracture in Female Runners

CLARE E. MILNER; REED FERBER; CHRISTINE D. POLLARD; JOSEPH HAMILL; IRENE S. DAVIS

- Group with history of tibial stress fracture
  - Significantly greater instantaneous and average vertical loading rates and tibial shock
  - Magnitude of tibial shock successfully predicted 70% of cases



Clin Orthop Relat Res (2017) 475:1463–1469
DOI 10.1007/s11999-016-5131-6

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

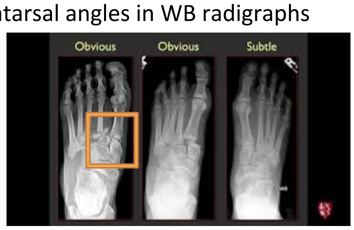
CrossMark

CLINICAL RESEARCH

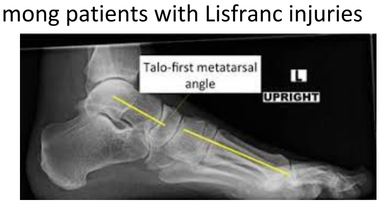
Is Pes Cavus Alignment Associated With Lisfranc Injuries of the Foot?

Jeremy D. Podolnick MD, Daniel S. Donovan MD, Nicholas DeBellis MD, Alejandro Pino MD

- Measured Talonavicular and talo-first metatarsal angles in WB radigraphs



- Patients:
  - Higher talo-first angle (5.7 deg)
  - Greater talonavicular angle (6.17 deg)
  - Less talar uncovering (6.7 deg)
- Cavus midfoot alignment was more prevalent among patients with Lisfranc injuries



Journal of Athletic Training 2014;49(3):290–296
doi: 10.4085/1062-6050-49.3.05
© by the National Athletic Trainers' Association, Inc
www.natajournals.org

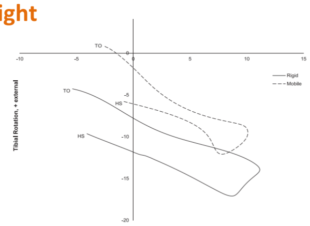
original research

Increased Medial Longitudinal Arch Mobility, Lower Extremity Kinematics, and Ground Reaction Forces in High-Arched Runners

D. S. Blaise Williams III, PhD, MPT*; Robin N. Tierney, DPT†; Robert J. Butler, PhD, DPT‡

- Screened arches for height and mobility in runners
  - normal height but rigid
  - Compared to
  - highest arches but mobile

- Mobile arches (even though higher)
  - Decreased tibial IR excursion
  - Decreased peak vertical GRF values
  - Decreased vertical loading rates
- **Mobility of arch more important than height**

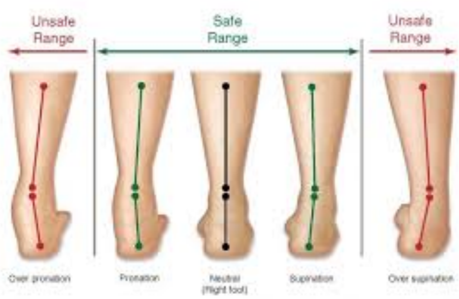


You can't just look at arch height, you have to assess the accessory mobility of the foot

Increased Pes Cavus Recap

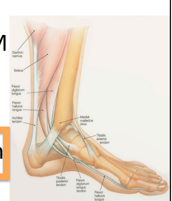
- Decreased deformation of medial longitudinal arch: increases pressures
- Less knee flexion excursion, increased vertical loading rates, increased tibial shock
- Increased lower leg stiffness/decreased shock absorption
- Associated with tibial stress fractures and Lisfranc sprains
- High mobile arch associated with better loading/ shock absorption than rigid, normal height arch

Both ends of the spectrum



Ankle and Foot Impairments

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits



Insufficient Plantar Flexor Strength

ORIGINAL ARTICLE

Muscle Strength and Flexibility Characteristics of People Displaying Excessive Medial Knee Displacement

David R. Bell, MEd, ATC, Darin A. Padua, PhD, ATC, Michael A. Clark, DPT, MS, PES, CES

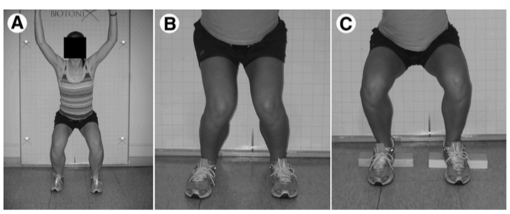


Fig 1. (A) Control subject during the overhead squat task. The mid-patella stays over the foot during the squat. (B) MKD subject during the overhead squat. The mid-patella is medial to great toe. (C) MKD subject performing the overhead squat on the heel lift (2×4 wooden block). MKD is corrected and mid-patella stays over the foot during the squat.

- Significant decrease in plantar flexors
  - 17% weaker gastrocnemius
- Medial gastroc acts as dynamic knee stabilizer against knee valgus *(Lloyd and Buchanan, 01)*

Table 2: Normalized Peak Isometric Strength Values Between Groups

Variables	Control	Medial Knee Displacement	*P*	Effect Size Partial η^2	Observed Power
Hip extension	16.4±3.6 (14.8–18.0)	19.5±3.3 (17.8–21.2)	.01*	.17	.74
Hip abduction	16.9±4.7 (15.2–18.7)	18.5±2.2 (16.7–20.3)	.21	.05	.24
Hip adduction	16.4±3.0 (15.1–17.7)	18.2±2.6 (16.8–19.5)	.06	.09	.46
Hip internal rotation	5.9±1.7 (5.3–6.7)	5.9±1.3 (5.2–6.6)	.88	.001	.05
Hip external rotation	12.5±2.2 (11.6–13.5)	14.1±1.9 (13.1–15.1)	.03*	.13	.59
Ankle dorsiflexion	16.7±2.0 (15.8–17.5)	17.1±1.7 (16.2–18.0)	.50	.01	.10
Ankle plantarflexion	15.8±3.0 (14.5–17.1)	13.1±2.6 (11.8–14.4)	.007*	.19	.80

NOTE. Values are normalized using Jaric method and are mean ± SD (95% CI).
*Significantly different between groups.

Journal of Athletic Training 2015;50(2):117–125
doi: 10.4085/1062-6050-49.3.90

www.natajournals.org

original research

High-Intensity Running and Plantar-Flexor Fatigability and Plantar-Pressure Distribution in Adolescent Runners

- Had subjects perform high intensity running to exhaustion
- Loading increased under the medial arch in plantar flexor fatigue state
  - 9.5% mean area
  - 7.2% relative load

Journal of Athletic Training 2008;43(1):51–54

www.nata.org/jat

original research

Eccentric Plantar-Flexor Torque Deficits in Participants With Functional Ankle Instability

Jason Fox, MS, LAT, ATC; Carrie L. Docherty, PhD, LAT, ATC; John Schrader, HSD, LAT, ATC; Trent Applegate, HSD, MPH

- Significant deficit in plantar flexor torque identified in subjects with ankle instability

Journal of Athletic Training 2013;48(5):610–620
doi: 10.4085/1062-6050-48.3.23

www.natajournals.org

original research

Lower Extremity Muscle Strength After Anterior Cruciate Ligament Injury and Reconstruction

Abbey C. Thomas, PhD, ATC*; Mark Villwock, MS†; Edward M. Wojtys, MD‡; Riann M. Palmieri-Smith, PhD, ATC†

- Significant PF weakness post injury and continued post rehabilitation in ACLR

CLINICAL PRAC

Achilles Pai... Tendinitis

CLINICAL PRACTICE GUIDELINES

Achilles Pain, Stiffness, and Muscle Power Deficits: Midportion Achilles Tendinopathy Revision 2018

Clinical Practice Guidelines Linked to the International Classif... Disability and Health Fr... of the American Physi...

II Decrea... with Achilles patholo... when comparing the... runners. While statis... been shown that the... strength.[24] A more r... isokinetic dynamome... Belgium military recr... tendinopathy during... 11.1 more Nm, respe... Because this study f... low plantar flexion st... reported that subject... concentric heel raise... the unaffected or lea... works, it seems that... Achilles tendinopath... flexion torque.

...has been associated ...antar flexion strength ...olleagues[118] ...erform a maximal ...ring the affected to ...based on these ...ed risk of developing ...generate a plantar

Decreased plantar flexor torque associated with Achilles tendinopathy

J Sci Med Sport. 2009 Nov;12(6):594-602. doi: 10.1016/j.jsams.2008.12.628. Epub 2009 Feb 20.

Raising the standards of the calf-raise test: a systematic review.

Hébert-Losier K[1], Newsham-West RJ, Schneiders AG, Sullivan SJ.

- Large inconsistency in evaluation purpose, test parameters, outcome measurements, reliability and validity
- Parameters most often used
  - Knee extended position
  - 1 repetition per 2 seconds
  - Number of repetitions
- Overall mean
  - **Norms 25.3**
  - Pathology 17.6

Brazilian Journal of Physical Therapy 2017;21(5):344–349

abrapg ft

Brazilian Journal of Physical Therapy

BJPT

ORIGINAL RESEARCH

Reference values for the bilateral heel-rise test

Débora Pantuso Monteiro, Raquel Rodrigues Britto, Guilherme Augusto de Freitas Fregonezi, Fernando Augusto Lavezzo, Marconi Gomes da Silva, Danielle Aparecida Gomes Pereira

- 20-29 year old
  - M:
    - 85 reps (50th)
    - 160 reps (90th)
  - F
    - 57 reps (50th)
    - 124 reps (90th

Table 4 Data for the total number of plantar flexions in the bilateral HRT, stratified by gender and age group, expressed as 10th, 25th, 50th, 75th, and 90th percentiles

F	28.7	39.25	54.5	73.25	118.7

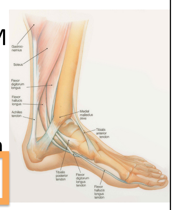
M, male; F, female; P10, 10th percentile; P25, 25th percentile; P50, 50th percentile; P75, 75th percentile; P90, 90th percentile.

Insufficient Plantar Flexor Strength Recap

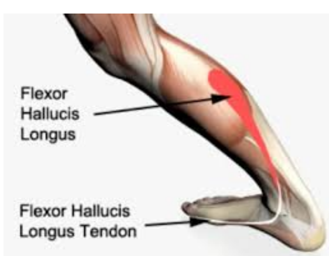
- Correlation to gastrocnemius weakness and medial knee displacement during squats: 17%
- Increased medial arch loading during running once fatigued
- Associated to ankle instability, ACLR, Achilles tendinopathy
- Heel raise norms
  - Single limb: 25 reps
  - Double limb: M (85-160), F (57-124)

Ankle and Foot Impairments

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits



Insufficient Great Toe Flexor Strength



ELSEVIER
Clinical Biomechanics 16 (2001) 783–792
CLINICAL BIOMECHANICS
www.elsevier.com/locate/clinbiomech

Forces acting in the forefoot during normal gait – an estimate

H.A.C. Jacob

Table 2
Forces, in % body weight, acting in the forefoot during the 'push-off' force peak, based on $F_1 = 23.8\%$ body weight and $G_1 = 5.0\%$ body weight, and as per Figs. 3 and 4

	Object	Symbol	% BW/angle
First ray	Flex.hall.long	F_{hl}	52.4
	Flex.hall.brev. (+abd.hall.)	$F_{hb'}$	35.5
	Peron.long.	F_{pl}	57.8
		$F_{pl(sagittal)}$	37.1
	IP joint resultant	R_1/θ_1	58.1/24°
	MP joint resultant	R_2/θ_2	86.4/4°
	Metatarsal head resultant	R_3/θ_3	119.2/48°
	TM joint resultant	R_4/θ_4	146.8/37°

ELSEVIER
Available online at www.sciencedirect.com
ScienceDirect
Journal of Electromyography and Kinesiology 18 (2008) 420–425
JOURNAL OF ELECTROMYOGRAPHY KINESIOLOGY
www.elsevier.com/locate/jelekin

Fatigue of the plantar intrinsic foot muscles increases navicular drop

Donella L. Headlee [a], Jamie L. Leonard [b], Joseph M. Hart [a], Christopher D. Ingersoll [a], Jay Hertel [a,*]
[a] University of Virginia Exercise and Sports Injury Laboratory P.O. Box 400407, Charlottesville, VA 22904-4407, United States
[b] Department of Kinesiology, Health and Human Services Building, University of Toledo, Toledo, OH 43606, United States

Received 13 March 2006; received in revised form 30 October 2006; accepted 3 November 2006

- Navicular drop measured pre/post fatiguing exercise of flexor intrinsics
- Performed 75 repetitions of isotonic contractions

18% increased in drop post fatigue

J. Phys. Ther. Sci. 28: 2241–2244, 2016
The Journal of Physical Therapy Science
SPTS

Original Article

Correlation between toe flexor strength and ankle dorsiflexion ROM during the countermovement jump

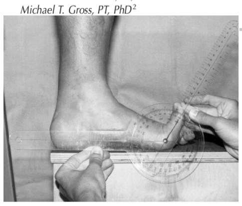
Sung Joon Yun, PT, MSc[1, 2], Moon-Hwan Kim, PT, PhD[2], Jong-Hyuck Weon, PT, PhD[3], Young Kim, PT, PhD[4], Sung-Hoon Jung, PT, BHSc[5], Oh-Yun Kwon, PT, PhD[5]*
[1] Department of Rehabilitation Therapy, Graduate School, Yonsei University, Republic of Korea
[2] Department of Reh... Republic of Kor...
[3] Department of ...
[4] Department of ... Republic of Kor...
[5] Department of ... on Movement A... Republic of Kor...

- High correlation between flexor strength and jump height
- 58.5 % total variation

Abstract. [Purpose] This study assessed the relationships between peak toe flexor muscle strength, ankle dorsiflexion range of motion, and countermovement jump height. [Subjects and Methods] Eighteen healthy volunteers participated in the study. Each participant completed tests for peak toe flexor muscle strength, ankle dorsiflexion range of motion, and countermovement jump height. [Results] The results showed (1) a moderate correlation be-

Toe Flexors Strength and Passive Extension Range of Motion of the First Metatarsophalangeal Joint in Individuals With Plantar Fasciitis

LCDR Rachel H. Allen, PT, MS[1]
Michael T. Gross, PT, PhD[2]



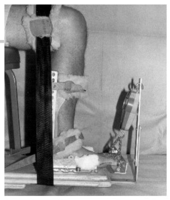


FIGURE 4. Apparatus used for measurement of toe flexors strength. The subject's distal femur, leg, and foot are stabilized by restraining straps. Each subject was asked to pull down with their toes on an aluminum bar that was attached to an electronic strain gauge scale that records force in N.

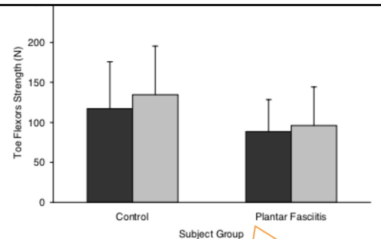


FIGURE 7. Mean toe flexors strength ... ed (black bar)

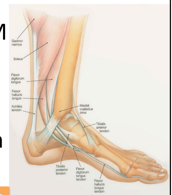
- Subjects with unilateral plantar fasciitis demonstrated weaker toe flexors than the control subjects.

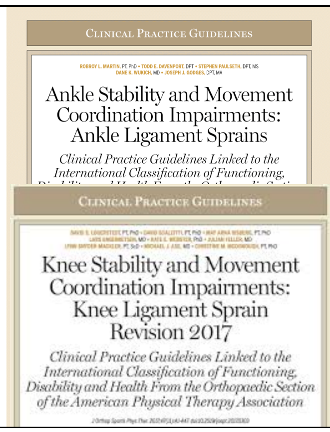
Insufficient Great Toe Flexor Strength Recap

- High peak forces on big toe flexors at push off
- Fatigue associated with increased navicular drop
- High correlation between flexor strength and jump height
- Weakness correlated to plantar fascitis

Ankle and Foot Impairments

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits




CLINICAL PRACTICE GUIDELINES

Ankle Stability and Movement Coordination Impairments: Ankle Ligament Sprains

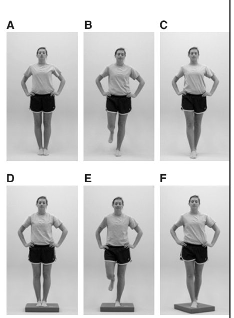
Clinical Practice Guidelines Linked to the International Classification of Functioning,

CLINICAL PRACTICE GUIDELINES

Knee Stability and Movement Coordination Impairments: Knee Ligament Sprain Revision 2017

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association

- Risks:
  - SLS < 30 sec EO, 25 sec EC)
  - BESS > 13 errors
  - SEBT (Y): > 4cm ant, < 94% composite



The evidence can guide your movement analysis

Ankle and Foot Interventions:

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits

To improve dorsiflexion

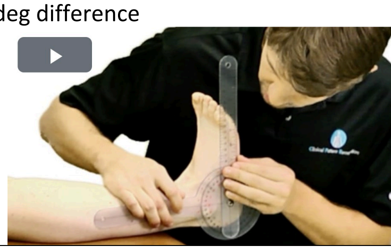
Immediate combined effect of gastrocnemius stretching and sustained talocrural joint mobilization in individuals with limited ankle dorsiflexion: A randomized controlled trial

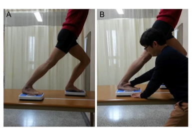
Min-Hyeok Kang [a], Jae-Seop Oh [b,*], Oh-Yun Kwon [c], Jong-Hyuk Weon [d], Duk-Hyun An [b], Won-Gyu Yoo [b]

Manual Therapy 20 (2015) 827e834

24 male subjects

- <10 deg dorsiflexion knee straight
- >10 deg dorsiflexion knee bent
- >5 deg difference





Stretching and Manual Therapy

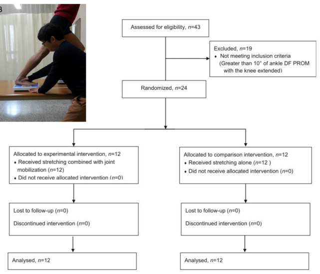
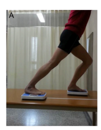


Fig. 1. Flow diagram of participants. Abbreviations: DF, dorsiflexion, PROM, passive range of motion.



Stretching only

Table 4
Changes in outcome measure variables between pre- and post-interventions.

Measure/group	Pre-intervention[a]	Post-intervention[a]	Within-group change[b]	Between-group change[b]
Time to heel-off (% stance phase)				
Stretching combined with joint mobilization	46.57 ± 8.05	49.56 ± 7.73	2.99 (1.00, 4.98)‡	3.82 (1.35, 6.30)‡
Stretching alone	48.91 ± 7.43	48.08 ± 7.08	−0.83 (−2.55, 0.89)	
Ankle DF before heel-off (°)				
Stretching combined with joint mobilization	8.56 ± 2.47	9.80 ± 3.36	1.24 (0.19, 2.29)‡	1.50 (0.33, 2.67)‡
Stretching alone	8.19 ± 2.07	7.93 ± 2.33	−0.26 (−0.93, 0.40)	
Ankle DF PROM (°)				
Stretching combined with joint mobilization	5.11 ± 2.76	8.83 ± 2.58	3.72 (2.34, 5.11)‡	1.47 (−0.36, 3.30)
Stretching alone	5.11 ± 3.01	7.36 ± 3.11	2.25 (0.89, 3.61)‡	
Posterior talar glide (°)				
Stretching combined with joint mobilization	15.14 ± 5.61	19.47 ± 5.40	4.33 (2.72, 5.94)‡	4.61 (2.72, 6.50)‡
Stretching alone	15.06 ± 3.70	14.78 ± 3.28	[illegible]	
Displacement of the MTJ (mm)				
Stretching combined with joint mobilization	11.91 ± 2.27	13.82 ± 1.93	1.91 (1.27, 2.55)‡	0.18 (−1.42, 1.79)
Stretching alone	11.67 ± 3.05	13.39 ± 3.64	1.73 (0.15, 3.31)‡	

‡$p < 0.05$.
Abbreviations: DF, dorsiflexion, MTJ: myotendinous junction, PROM, passive range of motion.
[a] Values are means ± SD.
[b] Values are means (95% CI).

Both groups:
improved in dorsiflexion ROM

Manual therapy and stretch group:
- Increased- Time to heel-off
- Increased- Ankle dorsiflexion before heel off
- Increased- Talocrural posterior glide

Changes in Kinetic, Kinematic, and Temporal Parameters of Walking in People With Limited Ankle Dorsiflexion: Pre-Post Application of Modified Mobilization With Movement Using Talus Glide Taping

Ji-yeon Yoon, PhD,[a] Young-in Hwang, PhD,[b] Duk-hyun An, PhD,[c] and Jae-seop Oh, PhD[c]

J Manipulative Physiol Ther
2014;37:320-325

MWM taping for Dorsiflexion

1. Place foot on chair (40cm height)
2. Position ankle in closed-packed dorsiflexion
3. Apply tape to plantar surface of the calcaneus from lateral to medial side

Fig 1. *Modified movement with mobilization using talus glide taping. Arrow indicates inferior and posterior force directions. (Color version of figure is available online.)*

Table 2. *Mean Values of Recorded Variables*

	Mean ± SD				
Variables	Before	Immediately	5-min walking	F	*P*
Ankle dorsiflexion (°)	5.89 ± 2.17	6.11 ± 1.81	12.11 ± 1.78	45.495	<.001[a,b]
Stance time (s)	0.63 ± 0.06	0.63 ± 0.05	0.62 ± 0.06	0.522	.603
Time to heel off (s)	0.38 ± 0.04	0.39 ± 0.05	0.42 ± 0.06	5.720	.013[a,b]
Maximum force of hindfoot (kg/BW)	0.58 ± 0.12	0.58 ± 0.12	0.64 ± 0.10	3.779	.045[a]
Maximum force of forefoot (kg/BW)	0.93 ± 0.12	0.93 ± 0.11	0.90 ± 0.09	1.695	.215
Force-time integral of hindfoot (kg/s)	7.77 ± 2.54	7.80 ± 2.36	8.78 ± 2.76	3.958	.040[a]
Force-time integral of forefoot (kg/s)	16.63 ± 4.63	16.18 ± 5.06	15.21 ± 4.80	5.811	.013[a]

[a] Significant difference between before and 5-minute walking ($P < .05$).
[b] Significant difference between immediately and 5-minute walking $P < .05$).

- Five minutes of walking with modified MWM using talus gliding taping was effective in improving passive ankle dorsiflexion ROM.

Improved time to heel off and dynamic plantar loading

- Time to heel off comprises about two-thirds of the stance phase during normal gait

Increasing flexibility without power loss…

ROLLER MASSAGER IMPROVES RANGE OF MOTION OF PLANTAR FLEXOR MUSCLES WITHOUT SUBSEQUENT DECREASES IN FORCE PARAMETERS

Israel Halperin[1]
Saied Jalal Aboodarda[1]
Duane C. Button[1]
Lars L. Andersen[2]
David G. Behm[1]

The International Journal of Sports Physical Therapy | Volume 9, Number 1 | February 2014 | Page 92

Figure 5. Boot apparatus for measuring the maximal voluntary contraction with the plantar flexors.

Figure 6. In-line lunge testing procedure.

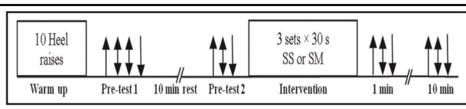
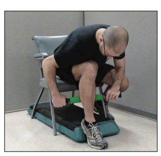


Figure 1. *The experimental design of the study. Note: ↑ = measurement of ankle range of motion; ↕ = measurement of plantar flexors' maximal voluntary contraction; ↓ = performance of the balance test. SM = Self Massage. SS = Static Stretching.*



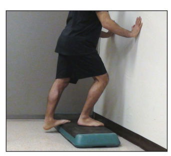
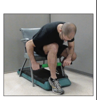
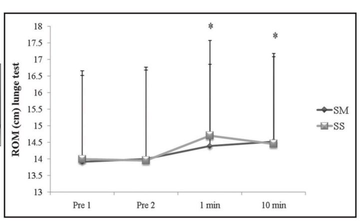


Figure 4. Static stretching position for the plantar flexors.

Both improve dorsiflexion





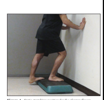
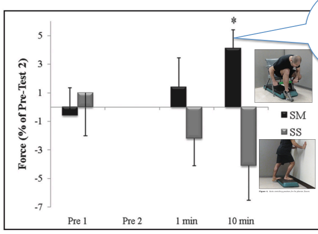


Figure 7. *Range of motion (cm) in Lunge Test. SM = Self Massage. SS = Static Stretching. * = Significantly greater than both Pre-test 1 and Pre-test 2.*

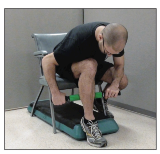
Plantar flexion force production



Increase in plantar flexion force production

Figure 8. *Relative changes in plantar flexion force as a % of pre-test 2. SM = Self Massage. SS = Static Stretching. * = SM is significantly greater than SS.*

Clinical pearl:



- Dorsiflexion range of motion improved with roller and self stretch
- The use of a roller massage prior to an activity that relies on maximum strength and power may be advantageous

Two-Week Joint Mobilization Intervention Improves Self-Reported Function, Range of Motion, and Dynamic Balance in Those With Chronic Ankle Instability

Matthew C. Hoch,[1] Richard D. Andreatta,[2] David R. Mullineaux,[3] Robert A. English,[4] Jennifer M. Medina McKeon,[5] Carl G. Mattacola,[5] Patrick O. McKeon[5]

J Orthop Res 30:1798–1804, 2012

Dosage

- 2, 2-min sets of Maitland Grade II talocrural joint traction

Dosage

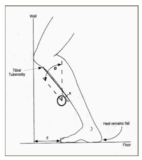
- 4, 2-min sets of Maitland Grade III talocrural joint mobilization with 1 min of rest between sets

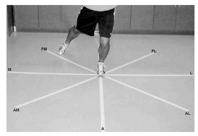
Dosage

- Total treatment 12 min (4 min of traction and 8 min of joint mobilization)
- Large-amplitude, 1-s rhythmic oscillations from the joint's mid-range to End range with translation taken to tissue resistance

Dependent Variable	Baseline	Pre-Intervention	Post-Intervention	1-Week Follow-up	MDC
Function	: 13.11	78.27 ± 12.62	87.30 ± 11.07[a,b]	86.80 ± 11.06[a,b]	3.96
	: 14.72	58.59 ± 11.08	73.69 ± 17.65[a,b]	74.21 ± 18.94[a,b]	7.90
Dorsiflexion range of motion		10.83 ± 3.86	12.18 ± 3.65[a,b]	12.29 ± 3.58[a,b]	0.2
		76.18 ± 5.76	78.30 ± 5.63[a,b]	78.71 ± 4.97[a,b]	1.56
Star excursion balance test		91.86 ± 10.33	96.23 ± 10.95[a,b]	97.47 ± 11.20[a,b]	3.36
		87.15 ± 12.60	91.92 ± 11.15[a,b]	93.09 ± 12.96[a,b]	4.28

[a]Significant increase compared to baseline ($p \leq 0.05$). [b]Significant increase compared to pre-intervention ($p \leq 0.05$).





Ankle and Foot Interventions:

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits

Increasing first MTP dorsiflexion

The Effect of Sesamoid Mobilization, Flexor Hallucis Strengthening, and Gait Training on Reducing Pain and Restoring Function in Individuals With Hallux Limitus: A Clinical Trial

Jennifer Shamus, PT, PhD, CSCS[1]
Eric Shamus, PT, PhD, CSCS[2]
Rita Nacken Gugel, PhD[3]
Bernard S. Brucker, PhD, ABRP[4]
Cindy Skaruppa, PhD[5]

J Orthop Sports Phys Ther 2004;34:368-376.

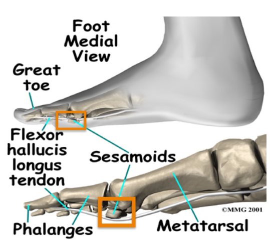
Intervention protocol

- Hot whirl pool 102 deg F- 15 min
- Ultrasound 3-MHz 50% pulsed at 1.0 W/cm2 for 8 min to first MTP
- Gastrocnemius stretch (3x30 sec holds)
- Supine hamstring stretch (3x30 sec holds)
- Passive ROM for toe extension
- Dorsal glides and distraction for first MTP
- Pre-mod e-stim at first MTP region

Improve soft tissue extensibility

Improve lower quarter sagittal plane mobility

Sesamoid Joint Mobilization



Sesamoid Joint Mobilization

- Grade III
- Distal glides
- No > 20 deg of MTP movement
- 1 minute each, 2 full glides per second


FIGURE 2. Joint mobilization for the sesamoid.

Gait training cue:

- 50 feet
- "Push your big toe down into the ground now and propel yourself forward"
- "Push" was repeated each time the foot passed through terminal stance

Results

TABLE 2. Descriptive data (mean ± SD) and statistical analysis for all 3 dependent variables; first metatarsophalangeal joint extension passive range of motion (MPJ PROM), flexor hallucis strength (FH strength), and pain level.

Dependent Variables	Control Group (n = 10)	Experimental Group (n = 10)	P*
MPJ PROM (°)			
Pretest	39.7 ± 18.7	41.2 ± 10.3	>.05
Posttest	54.1 ± 12.7	83.9 ± 6.4	<.001
Change	14.4 ± 8.0[†]	42.7 ± 7.8[†]	
FH strength (kg)			
Pretest	2.7 ± 1.6	1.9 ± 0.9	>.05
Posttest	3.4 ± 1.6	5.4 ± 1.5	<.001
Change	0.7 ± 0.4	3.5 ± 1.0[†]	
Pain level[‡]			
Pretest	6.8 ± 1.6	6.8 ± 1.5	>.05
Posttest	4.2 ± 1.0	0.4 ± 0.5	<.001
Change	2.6 ± 1.1[†]	6.4 ± 1.3[†]	

* Difference between groups.
[†] Indicates a significant change from pretest to posttest ($P<.001$).
[‡] Measured on a 0 to 10 verbal analog scale (0 = no pain, 10 = most severe pain you can imagine).

ROM increased 42.7 deg

Strength increased 3.5 kg

Pain level decreased 6.4

Ankle and Foot Interventions:

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7. Postural/ balance control deficits

Strength training for plantar fasciitis and the intrinsic foot musculature: A systematic review

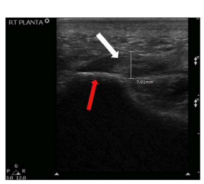
Dean Huffer [a, 1], Wayne Hing [b, *], Richard Newton [c], Mike Clair [d]

Physical Therapy in Sport 24 (2017) 44e52

- There is limited external validity for short foot exercise
- Toe flexion of all interphalangeal and metatarsophalangeal joints against resistance contribute to improved intrinsic foot musculature functional performance

- Minimal running shoes have also shown hypertrophic changes in intrinsic foot muscles in asymptomatic populations

- Despite no plantar fascia thickness changes being observed through high-load plantar fascia resistance training there are indications that it may aid in a quicker reduction of pain and improvements in function



Gait & Posture 29 (2009) 172–187

Contents lists available at ScienceDirect

Gait & Posture

journal homepage: www.elsevier.com/locate/gaitpost

Review

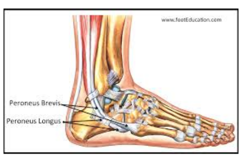
Effect of foot posture, foot orthoses and footwear on lower limb muscle activity during walking and running: A systematic review

George S. Murley[a,b,*], Karl B. Landorf[a,b], Hylton B. Menz[b], Adam R. Bird[a,b]

[a] Department of Podiatry, Faculty of Health Sciences, La Trobe University, Bundoora, VIC 3086, Australia
[b] Musculoskeletal Research Centre, Faculty of Health Sciences, La Trobe University, Bundoora, VIC 3086, Australia

- 38 articles looking at foot posture, foot orthosis and footwear on lower limb EMG activity

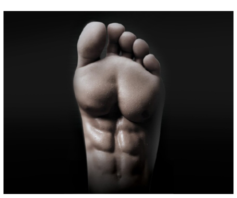
- Pronated foot:
  - higher EMG activity in invertors (Tibialis ant and post, FHL) and lower in evertors (peroneus longus)
- With orthoses:
  - increased peroneus longus amplitude

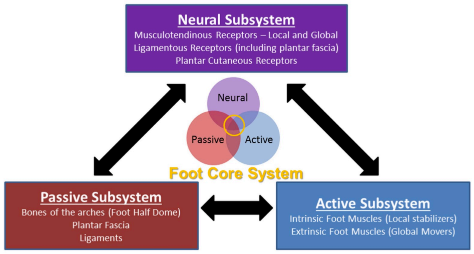


The foot core system: a new paradigm for understanding intrinsic foot muscle function

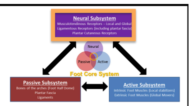
Patrick O McKeon,[1] Jay Hertel,[2] Dennis Bramble,[3] Irene Davis[4]

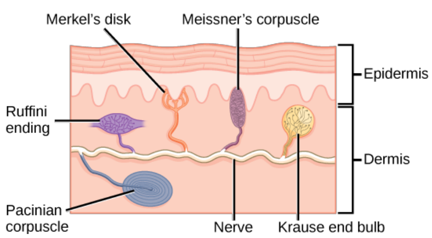
McKeon PO, Hertel J, Bramble D, et al. Br J Sports Med 2015;49:290.





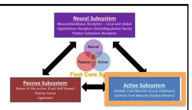
Neural subsystem

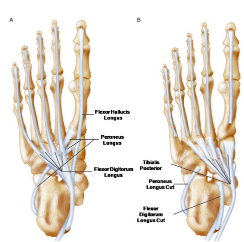




Mechanoreceptors

Active subsystem



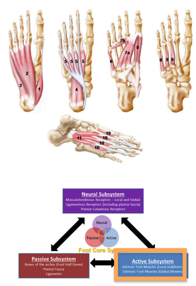


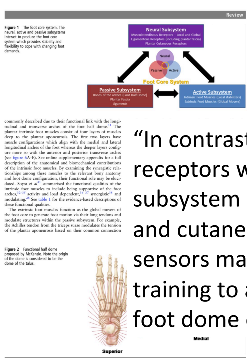
Intrinsic muscles

Extrinsic muscles

Active: Intrinsic muscles

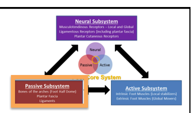
- Not designed to generate large forces
- "Rather, their anatomical positions and alignments suggest that they are advantageously positioned to provide immediate sensory information, via the stretch response, about changes in the foot dome posture."

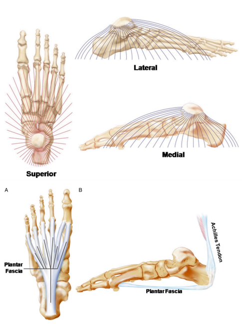


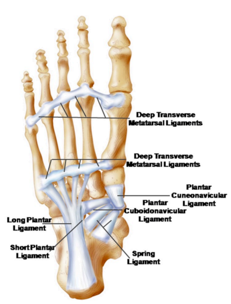


"In contrast to input from sensory receptors within the passive subsystem (eg, capsuloligamentous and cutaneous receptors), these sensors may be modulated through training to alter their sensitivity to foot dome deformation."

Passive subsystem



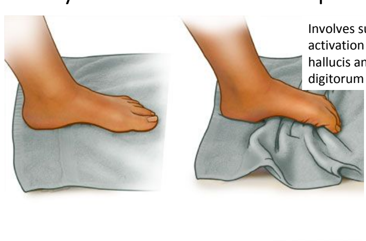




Intrinsic foot muscle test

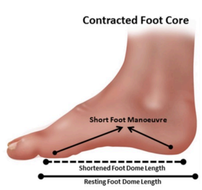
Foot Core Training

- Traditionally towel curls and marble pick up



Involves substantial activation of flexor hallucis and flexor digitorum longus

Short foot



"Emphasis should be placed on the patient learning to sense subtalar neutral with the calcaneus and the metatarsal heads on the ground and the toes neither flexed nor extended"

Doming progression- Sitting

Sit to stand

Bipedal-->Unipedal

Bilateral → Single leg hops

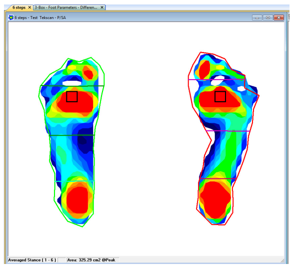
Hop off step

Ankle and Foot Interventions:

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits

Supporting the rigid foot…

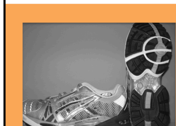
- Can reduce foot pressure…



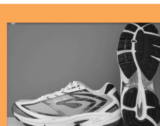
Effect of Neutral-Cushioned Running Shoes on Plantar Pressure Loading and Comfort in Athletes With Cavus Feet

Caleb Wegener,[*,†] B App Sc (Pod) Hons, Joshua Burns,[†,‡] PhD, and
Stefania Penkala,[†,§] Grad Dip Ex Spr Sc
From the [†]Podiatry Program, School of Biomedical and Health Sciences, University of Western Sydney, Sydney, NSW, Australia, the [‡]Discipline of Paediatrics and Child Health, The University of Sydney/Institute for Neuromuscular Research, The Children's Hospital at Westmead, Sydney, NSW, Australia, and the [§]Faculty of Health Sciences, The University of Sydney, Sydney, NSW, Australia

The American Journal of Sports Medicine,
Vol. 36, No. 11 (2139-2146)



Asics Nimbus 6

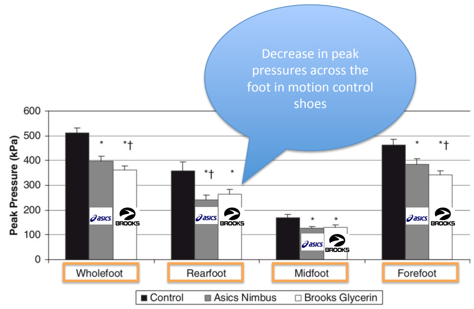


Brooks Glycerin

Control: Dunlop volley

Motion control

Reduction in Peak pressure for motion control shoes

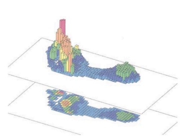


Mobilizing the rigid foot

The Effects of Range-of-Motion Therapy on the Plantar Pressures of Patients with Diabetes Mellitus

Jon R. Goldsmith, BS*
Roy H. Lidtke, DPM, CPed†
Susan Shott, PhD‡

Journal of the American Podiatric Medical Association • Vol 92 • No 9 • October 2002 483



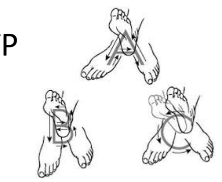
Alphabets/PROM MTP

Table 1. Outline of the Exercise Program

Warm-up
Draw the alphabet using the hallux, bilaterally

Stretching Exercises (5 sets each)
1. Passive dorsiflexion and plantarflexion of the metatarsophalangeal joints, holding each direction for 10 sec
2. Active dorsiflexion and plantarflexion of the metatarsophalangeal joints, holding each direction for 10 sec
3. Seated passive dorsiflexion and plantarflexion with application of partial body weight at the metatarsophalangeal joints, holding each direction for 10 sec
4. Active dorsiflexion and plantarflexion of the ankles, holding each direction for 10 sec
5. Active supination and pronation of the subtalar joints, holding each direction for 10 sec
6. Standing gastrocnemius stretch, holding for 10 sec
7. Standing soleal stretch, holding for 10 sec

Cool-down
Soft-tissue manipulation, 30 sec at the forefoot, midfoot, rearfoot, and posterior aspect of the distal one-third of the leg, bilaterally



Weightbearing MTP Flexion/Extension

Table 1. Outline of the Exercise Program

Warm-up
Draw the alphabet using the hallux, bilaterally

Stretching Exercises (5 sets each)
1. Passive dorsiflexion and plantarflexion of the metatarsophalangeal joints, holding each direction for 10 sec
2. Active dorsiflexion and plantarflexion of the metatarsophalangeal joints, holding each direction for 10 sec
3. Seated passive dorsiflexion and plantarflexion with application of partial body weight at the metatarsophalangeal joints, holding each direction for 10 sec
4. Active dorsiflexion and plantarflexion of the ankles, holding each direction for 10 sec
5. Active supination and pronation of the subtalar joints, holding each direction for 10 sec
6. Standing gastrocnemius stretch, holding for 10 sec
7. Standing soleal stretch, holding for 10 sec

Cool-down
Soft-tissue manipulation, 30 sec at the forefoot, midfoot, rearfoot, and posterior aspect of the distal one-third of the leg, bilaterally

Intervention

Table 1. Outline of the Exercise Program

Warm-up
Draw the alphabet using the hallux, bilaterally

Stretching Exercises (5 sets each)
1. Passive dorsiflexion and plantarflexion of the metatarsophalangeal joints, holding each direction for 10 sec
2. Active dorsiflexion and plantarflexion of the metatarsophalangeal joints, holding each direction for 10 sec
3. Seated passive dorsiflexion and plantarflexion with application of partial body weight at the metatarsophalangeal joints, holding each direction for 10 sec
4. Active dorsiflexion and plantarflexion of the ankles, holding each direction for 10 sec
5. Active supination and pronation of the subtalar joints, holding each direction for 10 sec
6. Standing gastrocnemius stretch, holding for 10 sec
7. Standing soleal stretch, holding for 10 sec

Cool-down
Soft-tissue manipulation, 30 sec at the forefoot, midfoot, rearfoot, and posterior aspect of the distal one-third of the leg, bilaterally

Active supination/pronation

Table 1. Outline of the Exercise Program

Warm-up
Draw the alphabet using the hallux, bilaterally

Stretching Exercises (5 sets each)
1. Passive dorsiflexion and plantarflexion of the metatarsophalangeal joints, holding each direction for 10 sec
2. Active dorsiflexion and plantarflexion of the metatarsophalangeal joints, holding each direction for 10 sec
3. Seated passive dorsiflexion and plantarflexion with application of partial body weight at the metatarsophalangeal joints, holding each direction for 10 sec
4. Active dorsiflexion and plantarflexion of the ankles, holding each direction for 10 sec
5. Active supination and pronation of the subtalar joints, holding each direction for 10 sec
6. Standing gastrocnemius stretch, holding for 10 sec
7. Standing soleal stretch, holding for 10 sec

Cool-down
Soft-tissue manipulation, 30 sec at the forefoot, midfoot, rearfoot, and posterior aspect of the distal one-third of the leg, bilaterally

Calf and Soleus Stretch

Table 1. Outline of the Exercise Program

Warm-up
Draw the alphabet using the hallux, bilaterally

Stretching Exercises (5 sets each)
1. Passive dorsiflexion and plantarflexion of the metatarsophalangeal joints, holding each direction for 10 sec
2. Active dorsiflexion and plantarflexion of the metatarsophalangeal joints, holding each direction for 10 sec
3. Seated passive dorsiflexion and plantarflexion with application of partial body weight at the metatarsophalangeal joints, holding each direction for 10 sec
4. Active dorsiflexion and plantarflexion of the ankles, holding each direction for 10 sec
5. Active supination and pronation of the subtalar joints, holding each direction for 10 sec
6. Standing gastrocnemius stretch, holding for 10 sec
7. Standing soleal stretch, holding for 10 sec

Cool-down
Soft-tissue manipulation, 30 sec at the forefoot, midfoot, rearfoot, and posterior aspect of the distal one-third of the leg, bilaterally

@1mos: Decreased peak plantar pressures

Control group: Pressures increased

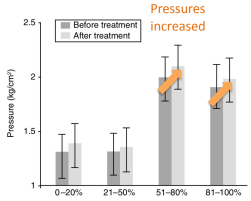


Figure 10. Dominant foot plantar pressures in the control group. Note the increase in pressure after 1 month, with the greatest pressures during the propulsive phases of the gait cycle.

Treatment group: Pressures decreased

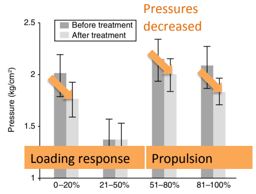


Figure 11. Dominant foot plantar pressures in the treatment group. The greatest changes occurred at the initial loading response and during the propulsive phases of the gait cycle. This may be due to the fact that the exercises focused on the ankle and first metatarsophalangeal joints, which may be more active during these periods.

Ankle and Foot Interventions:

1. Insufficient dorsiflexion ROM
2. Insufficient big toe extension ROM
3. Excessive pronation (planus)
4. Excessive supination (cavus)
5. Insufficient plantar flexor strength
6. Insufficient big toe flexor strength
7. Postural/ balance control deficits

Tendon loading and strengthening

Not All Tendons Are Created Equal: Implications for Differing Treatment Approaches

LORI A. MICHENER, *PT, PhD, ATC, SCS, FAPTA*
Division of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA.

KORNELIA KULIG, *PT, PhD, FAPTA*
Division of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA.

J Orthop Sports Phys Ther 2015;45(11):829-832. doi:10.2519/jospt.2015.0114

J Orthop Sports Phys Ther 2015;45(11):829-832. doi:10.2519/jospt.2015.0114

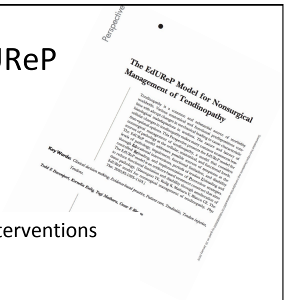
Tendinopathy

- Develops predominantly from:
  - Excessive compression
  - Tensile load (muscle from muscle contraction or lengthening)
  - Movement strategies

EdUReP

[EDITORIAL]

Not All Tendons Are Created Equal: Implications for Differing Treatment Approaches



Perspective

The EdUReP Model for Nonsurgical Management of Tendinopathy

Educational interventions
Unloading
Reloading
Prevention strategies

Dosing the tendon reload process?

[CLINICAL COMMENTARY]

KARIN GRÄVARE SILBERNAGEL, PT, ATC, PhD • KAY M. CROSSLEY, BAppSc (Physio), PhD

A Proposed Return-to-Sport Program for Patients With Midportion Achilles Tendinopathy: Rationale and Implementation

J Orthop Sports Phys Ther 2015;45(11):876-886. Epub 21 Sep 2015.

Most common eccentric protocol:

- 3 sets of 15
- Twice per day
- Knee extended
- Knee slightly flexed

Dosage:

- Do exercise even if painful (stop if pain becomes disabling) and perform until it becomes pain free
- Once pain free, progressively add loads in either a backpack or in your hands until the exercise is again painful

Progressive tendon loading program

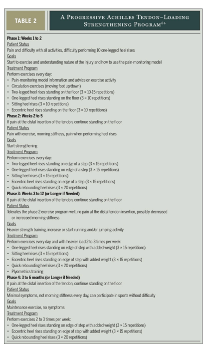


TABLE 2 A PROGRESSIVE ACHILLES TENDON–LOADING STRENGTHENING PROGRAM[64]

Phase 1: Weeks 1 to 2
Patient Status
Pain and difficulty with all activities, difficulty performing 10 one-legged heel rises
Goals
Start to exercise and understanding nature of the injury and how to use the pain-monitoring model
Treatment Program
Perform exercises every day:
- Pain-monitoring model information and advice on exercise activity
- Circulation exercises (moving foot up/down)
- Two-legged heel rises standing on the floor (3 × 10-15 repetitions)
- One-legged heel rises standing on the floor (3 × 10 repetitions)
- Sitting heel rises (3 × 10 repetitions)
- Eccentric heel rises standing on the floor (3 × 10 repetitions)

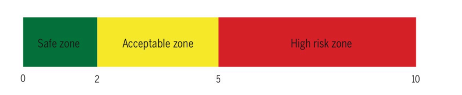
Phase 2: Weeks 2 to 5
If pain at the distal insertion of the tendon, continue standing on the floor
Patient Status
Pain with exercise, morning stiffness, pain when performing heel rises
Goals
Start strengthening
Treatment Program
Perform exercises every day:
- Two-legged heel rises standing on edge of a step (3 × 15 repetitions)
- One-legged heel rises standing on edge of a step (3 × 15 repetitions)
- Sitting heel rises (3 × 15 repetitions)
- Eccentric heel rises standing on edge of a step (3 × 15 repetitions)
- Quick rebounding heel rises (3 × 20 repetitions)

Phase 3: Weeks 3 to 12 (or Longer if Needed)
If pain at the distal insertion of the tendon, continue standing on the floor
Patient Status
Tolerates the phase 2 exercise program well, no pain at the distal tendon insertion, possibly decreased or increased morning stiffness
Goals
Heavier strength training, increase or start running and/or jumping activity
Treatment Program
Perform exercises every day and with heavier load 2 to 3 times per week:
- One-legged heel rises standing on edge of step with added weight (3 × 15 repetitions)
- Sitting heel rises (3 × 15 repetitions)
- Eccentric heel rises standing on edge of step with added weight (3 × 15 repetitions)
- Quick rebounding heel rises (3 × 20 repetitions)
- Plyometrics training

Phase 4: 3 to 6 months (or Longer if Needed)
If pain at the distal insertion of the tendon, continue standing on the floor
Patient Status
Minimal symptoms, not morning stiffness every day, can participate in sports without difficulty
Goals
Maintenance exercise, no symptoms
Treatment Program
Perform exercises 2 to 3 times per week:
- One-legged heel rises standing on edge of step with added weight (3 × 15 repetitions)
- Eccentric heel rises standing on edge of step with added weight (3 × 15 repetitions)
- Quick rebounding heel rises (3 × 20 repetitions)

Pain Monitoring Model

Numerical Pain Rating Scale (NPRS)



1. The pain is allowed to reach 5 on the NPRS during the activity.
2. The pain after completion of the activity is allowed to reach 5 on the NPRS.
3. The pain the morning after the activity should not exceed a 5 on the NPRS.
4. Pain and stiffness is not allowed to increase from week to week.

FIGURE 10. Pain-monitoring model.[64,66,71]

Acute **Phase 1**: Weeks 1 to 2

Patient Status
Pain and difficulty with all activities, difficulty performing 10 one-legged heel rises

Goals
Start to exercise and understanding nature of the injury and how to use the pain-monitoring model

Treatment Program

- Perform exercises every day:
  - *Pain monitoring model information and advice on exercise activity*
  - *Circulation exercises (moving foot up/ down)*
  - *Two-legged heel rises standing on the* ***floor*** *(3×10-15 repetitions)*
  - *One-legged heel rises standing on the* ***floor*** *(3×10 repetitions)*
  - *Sitting heel rises (3×10 repetitions)*
  - *Eccentric heel rises standing on the floor (3×10 repetitions)*

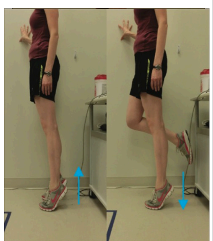


FIGURE 6. Eccentric heel rise standing on the floor.

Phase 2: Weeks 2-5

- If pain at the distal insertion of the tendon, continue standing on the floor
- **Patient Status**
  - Pain with exercise, morning stiffness, pain when performing heel rises
- **Goals**
  - Start strengthening

Treatment Program

- **Perform exercises every day:**
  - *Two legged heel rises standing on* ***edge of a step*** *(3×15 repetitions)*
  - *One legged heel rises standing on* ***edge of a step*** *(3×15 repetitions)*
  - *Sitting heel rises (3×15 repetitions)*
  - *Eccentric heel rises standing on* ***edge of a step*** *(3×15 repetitions)*
  - ***Quick rebounding*** *heel rises (3×20repetitions)*

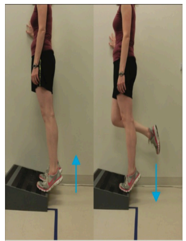


FIGURE 9. Eccentric heel rise standing on a step.

Phase 3: weeks 3 to 12 (or longer)

If pain at the distal insertion of the tendon, continue standing on the floor

Patient Status
- Tolerates the phase 2 exercise program well
- No pain at the distal tendon insertion
- Possibly decreased or increased morning stiffness

Goals
- Heavier strength training
- Increase or start running and/or jumping activity

Treatment Program

*Perform exercises every day and with heavier load **2 to 3 times** per week:*

*• One-legged heel rises **standing on edge** of step with **added weight** (3×15 repetitions)*

• Sitting heel rises (3×15 repetitions)

•Eccentric heel rises standing on edge of step with added weight (3×15 repetitions)

*• **Quick rebounding heel rises** (3×20 repetitions)*

• Plyometrics training

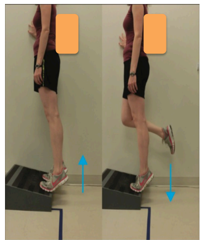


FIGURE 9. Eccentric heel rise standing on a step.

Phase 4: 3 to 6 months

If pain at the distal insertion of the tendon, continue standing on the floor

Patient Status

Minimal symptoms, not morning stiffness every day, can participate in sports without difficulty

Goals

Maintenance exercise, no symptoms

Treatment Program

- *Perform exercises **2 to 3 times per week:***
  *• One-legged heel rises **standing on edge** of step with **added weight** (3×15 repetitions)*
  •Eccentric heel rises standing on edge of step with added weight (3×15 repetitions)
  *• **Quick rebounding heel rises** (3×20 repetitions)*

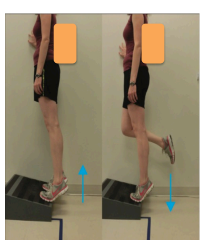


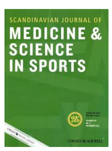
FIGURE 9. Eccentric heel rise standing on a step.

Clinical Pearl

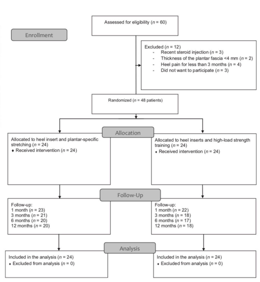
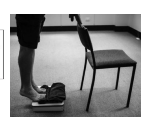
- Gradual reloading of tendons
- Mix of concentrics and eccentrics- limited range of movement
- Add velocity to the resistance training

High-load strength training improves outcome in patients with plantar fasciitis: A randomized controlled trial with 12-month follow-up

M. S. Rathleff[1], C. M. Mølgaard[2], U. Fredberg[3], S. Kaalund[4], K. B. Andersen[3], T. T. Jensen[4], S. Aaskov[5], J. L. Olesen[6,7]



Scand J Med Sci Sports. 2015 Jun;25(3):e292-300. doi: 10.1111/sms.12313. Epub 2014 Aug 21.

Why high load?

- The plantar fascia is made up of collagen type 1 fibers (Stecco et al., 2013)
- Large tensile forces have been associated with improvements in symptoms in other conditions involving degenerative changes, as seen in plantar fasciitis

High load strength training

Fig. 2. Unilateral heel raises were performed with a towel under the toes to increase dorsal flexion of the toes during heel raises.

"From a theoretical perspective, this was achieved using the windlass mechanism in combination with loading of the Achilles tendon."

Set up:

1. Unilateral heel raises with towel under toes (windlass mechanism)
2. Exercise on stairway or similar location
3. Towel was customized to ensure maximum toe dorsiflexion at the top of heel rise

Cues:

- 3 seconds up
- 2 second hold at the top
- 3 seconds down
- 12 repetition maximum for 3 sets

Dosage

Weeks	Resistance	Repetitions
0-2	12 rep max	3 sets
2-4	Add load with back pack 10RM	4 sets
4	8RM	5 sets

Every second day for 3 months

Foot Function Index

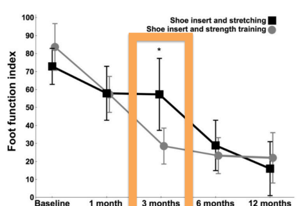


Fig. 4. Primary outcome (foot function index) at baseline a[illegible]2 months.

- At 3 months, Significant 29 point decrease in Foot Function Index (FFI)
- No significant difference compared to stretch at 1, 6 and 12 months

MCID: 7

Clinical pearl:

- High load strength training
- Yields quicker recovery at 3 months
- Efficient to perform
- Only required every 2nd day

Clinical Biomechanics 40 (2016) 14–19

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Clinical Biomechanics

journal homepage: www.elsevier.com/locate/clinbiomech

Lecture

Efficacy of a progressive resistance exercise program to increase toe flexor strength in older people

Karen J. Mickle [a,*,1], Peter Caputi [b], Jan M. Potter [c], Julie R. Steele [a]

[a] Biomechanics Research Laboratory, University of Wollongong, Northfields Ave, Wollongong, NSW 2522, Australia
[b] School of Psychology, University of Wollongong, Northfields Ave, Wollongong, NSW 2522, Australia
[c] Division of Aged Care, Illawarra Shoalhaven Local Health District, Wollongong Hospital, Wollongong, NSW 2500, Australia

- Resistance program focused on improving big toe flexor strength (supervised vs home)
- Monitored toe flexor strength, compliance, foot health and single leg balance

Only supervised group

- Significant increase in hallux strength (36%)
  - 1.7% Body weight increase
  - 12% decrease in fall risk
- Significance increase in Single limb balance (eyes open and closed)