

## Beyond Towel Curls: Specificity In Exercise Selection & Prescription

### FROM THE BOOT TO THE BEAM

Virtual Grand Rounds Sept. 2021

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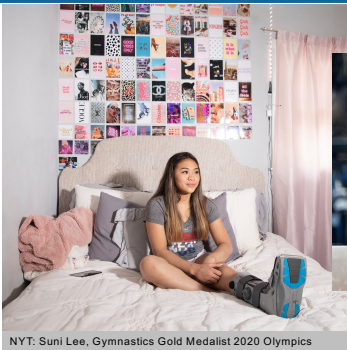
## Learning Objectives

- Recommend interventions with focus on arthrokinematics of the ankle.
- Summarize current research for foot and ankle examination and treatment.
- Explain exercise selection targeting the foot intrinsics and triceps surae complex.



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## Boot to Beam



NYT: Sunni Lee, Gymnastics Gold Medalist 2020 Olympics



TOKYO 2020

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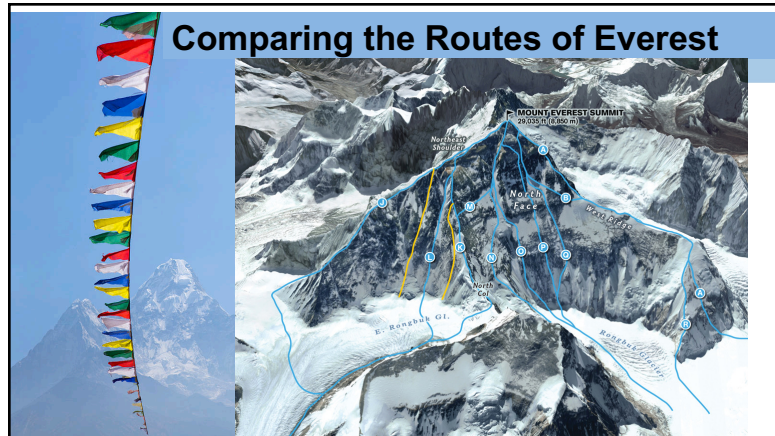
## START WITH THE BASICS

Toe Yoga  
Towel Curls  
Ankle bands  
Calf Raises  
Balance

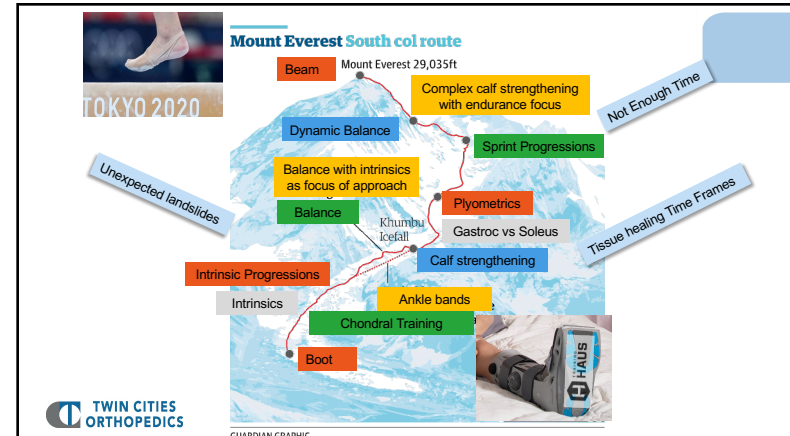
Then what?



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## Chondral Training

AOFA 2019 Conference:  
Stephanie Albin, DPT, OCS, FAAOMPT  
Assistant Professor, School of Physical Therapy,  
Regis University

**Chondral Training = High Reps with Low Load**  
Restoring arthrokinematics

Nustep or Bike with cues for ankle DF/PF  
AROM for ankle over small ball DF/PF 2 min  
CKC triple flexion on box (partial weight bearing) 2 min

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## Chondral Training

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## Chondral Training



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Trying to decide  
what tests to include



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## Examination Pearls

Weight-bearing lunge test (knee to wall test)



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## Weight-Bearing Lunge Research

1. Bennell K, Talbot R, Wajswelner H, Techovanich W, Kelly D. Intra-rater and inter-rater reliability of a weight-bearing lunge measure of ankle dorsiflexion. *Aust J Physiother* 1998a; 44: 175–180. (lunge and inclinometer reliable)
2. Chisholm MD, Birmingham TB, Brown J, MacDermid J, Chesworth BM. . Reliability and validity of a weight-bearing measure of ankle dorsiflexion range of motion. *Physiother Can*. 2012; 64 4: 347– 355. (lunge test valid)
3. Konor MM, Morton S, Eckerson JM, Grindstaff TL. Reliability of three measures of ankle dorsiflexion range of motion. *Int J Sports Phys Ther*. 2012;7(3):1–9 (lunge, inclinometer, and goniometer reliability)
4. Hall EA, Docherty CL. Validity of clinical outcome measures to evaluate ankle range of motion during the weight-bearing lunge test. *J Sci Med Sport* 2017;20:618-621. (max lunge distance and inclinometer valid)
5. Banwell HA, Uden H, Marshall N et al. The iPhone Measure app level function as a mea- suring device for the weight bearing lunge test in adults: a reliability study. *J Foot Ankle Res* 2019; 12: 37 (iphone app inclinometer)



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### Examination Pearls

**Calf endurance testing (modified simple)**

30 reps per minute using Metronome

**Stop test:**

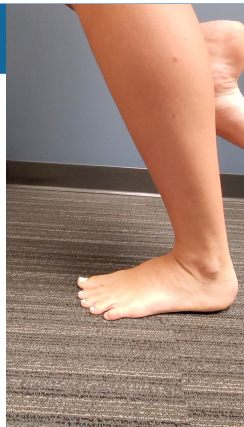
- Loss of heel height
- Loss of frequency
- Patient stops

**Compensation:**

- Long toe flexors
- Knee flexion

Silbernagel KG, Nilsson-Helander K, Thomee R, et al. A new measurement of heel-rise endurance with the ability to detect functional deficits in patients with Achilles tendon rupture. *Knee Surg Sports Traumatol Arthrosc* 2010;18:258-64.

Silbernagel KG, Steele R, Manal K. Deficits in heel-rise height and Achilles tendon elongation occur in patients recovering from an Achilles tendon rupture. *Am J Sports Med*. 2012;40(7):1504-1511.



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Atrophy?  
Recruitment?



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### Examination Pearls

**Calf Circumference:**

15 cm distal anteromedial tibial joint line  
(12-13cm if pediatric or < 5" tall)

The patient's legs should not touch the table or floor



Carmont MR, Silbernagel KG, Mathy A, Muji Y, Karlsson J, Maffulli n (2013) Reliability of achilles tendon resting angle and calf circumference measurement techniques. *Foot Ankle Surg* 19:245-249

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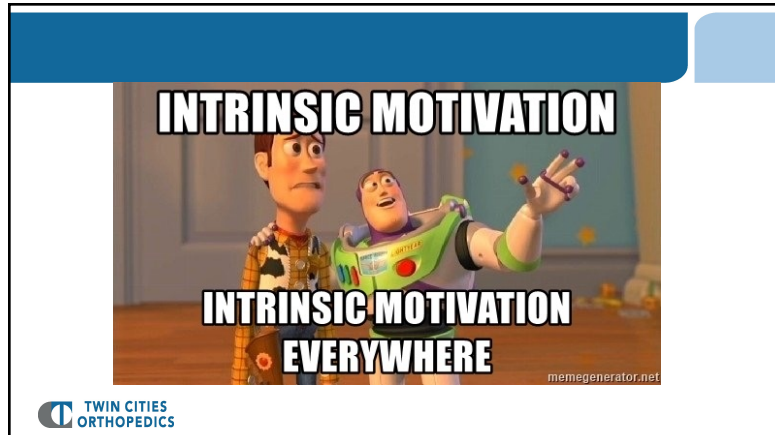
Atrophy?  
Recruitment?



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## Foot Strengthening Strategies

Tourillon, R., Gojanovic, B., & Fourchet, F. (2019). How to evaluate and improve foot strength in athletes: An update. *Frontiers in Sports and Active Living*, 1:46.

- Short foot exercise (SFE)
- Toe-Posture exercises (Lifts/spreads)
- Extrinsic Strengthening
- Forward lean/Reverse tandem gait
- Toe flexor strengthening
- Isometric to Plyometric progressions
- Minimalist or Barefoot walking/running
- NMES



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Authors	Population	Group exercises	Mediators	Results
Storck et al. (2018)	Long distance runners (n = 47)	Valsalva force = flexion loading gait + short foot exercise + ankle muscle strengthening for control group (control) + short foot exercise + ankle muscle strengthening for intervention group (SFE)	6 weeks 20 min daily Progression every 2 weeks: increasing load and speed of walking and running	1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2)
Storck et al. (2018)	Pre-plant (n = 41)	Short Foot Exercise (SFE) group Control group	6 weeks 20 min daily Progression every 2 weeks: increasing load and speed of walking and running	1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2)
Storck et al. (2018)	Healthy, recreationally active young adults (n = 16)	SFE exercises program Valsalva force Control group	4 weeks 20 min daily Progression every 2 weeks: increasing load and speed of walking and running	1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2)
Storck et al. (2018)	Healthy long distance runners (n = 33)	Foot and Ankle muscle strength training group Control group	6 weeks 20 min daily Progression every 2 weeks: increasing load and speed of walking and running	1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2)
Storck et al. (2018)	Middle distance runners (n = 30)	Valsalva force = walking backward Valsalva force = walking forward Valsalva force = walking side-to-side Valsalva force = walking forward and backward	4 weeks 20 min daily Progression every 2 weeks: increasing load and speed of walking and running	1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2)
Storck et al. (2018)	Healthy subjects (n = 16)	Valsalva force = walking backward Valsalva force = walking forward Valsalva force = walking side-to-side Valsalva force = walking forward and backward	4 weeks 20 min daily Progression every 2 weeks: increasing load and speed of walking and running	1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2)
Storck et al. (2018)	Plantar fasciitis (n = 15)	Foot exercise group Control group	6 weeks 20 min daily Progression every 2 weeks: increasing load and speed of walking and running	1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2) 1 peak torque force flexion (group 2)
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## Intrinsic vs Extrinsic

McKeon, P. O., Hertel, J., Bramble, D., & Davis, I. (2015). The foot core system: A new paradigm for understanding intrinsic foot muscle function. *British Journal of Sports Medicine*, 49(5), 290. doi:10.1136/bjsports-2013-092690

### Plantar Intrinsic: local stabilizers Originate and insert on the foot

1. Abductor hallucis
2. FDB
3. Abductor digiti minimi
4. Quadratus plantae
5. Lumbricals
6. Flexor digiti minimi
7. Adductor hallucis oblique
8. FHB
9. Plantar interossei
10. Dorsal interossei
11. Extensor Digitorum brevis

### Extrinsics: global movers Lower leg and cross ankle

- Plantar
1. FDL
  2. FHL
  3. Peroneus longus
  4. Tibialis posterior

- Dorsal
1. Tibialis anterior
  2. EHL
  3. EHB



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## Intrinsic Activation Validation

### Toe lifts and Toe spreading

Gooding, T. M., Feger, M. A., Hart, J. M., and Hertel, J. (2016). Intrinsic foot muscle activation during specific exercises: a T2 time magnetic resonance imaging study. *J. Athl. Train.* 51, 644-650. doi: 10.4085/1062-6050-51.10.07

### Dome exercise/ Short Foot Exercise (SFE)

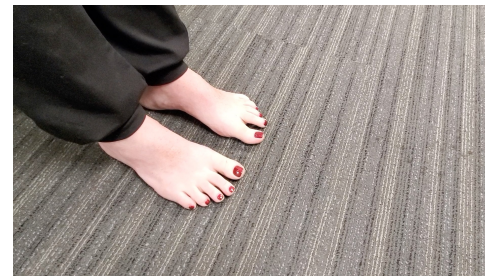
McKeon, P. O., Hertel, J., Bramble, D., & Davis, I. (2015). The foot core system: A new paradigm for understanding intrinsic foot muscle function. *British Journal of Sports Medicine*, 49(5), 290. doi:10.1136/bjsports-2013-092690

Passive, Active Assisted, Active



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## Intrinsic Assessment



Place foot into PF if you are getting too much extrinsic activation during assessment especially with SFE/Dome

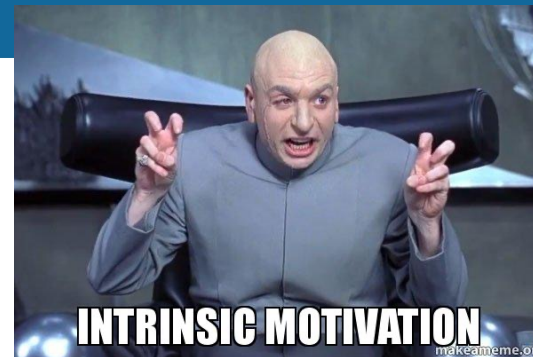
McKeon, P. O., Hertel, J., Bramble, D., & Davis, I. (2015).



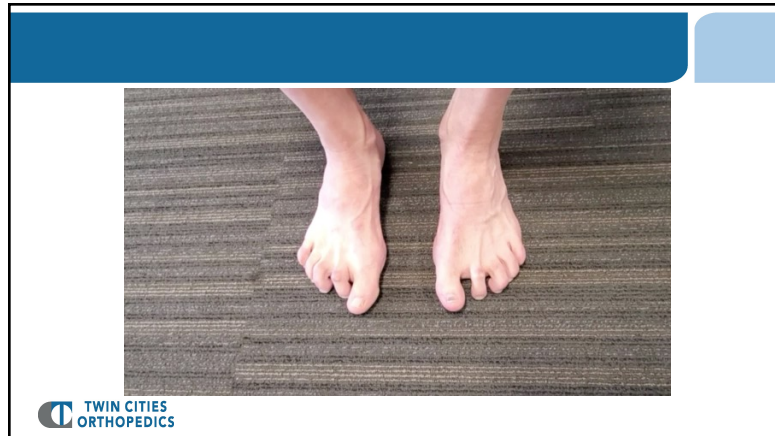
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### Intrinsic Progression- Spike Ball pickup

"Toe flexor grip exercises [with a spike ball] can improve function of the lesser toes, specifically the second and third digits, increasing contact time of the metatarsals during gait".

- 70 mm diameter ball
- Inflated to 8.5 psi
- Participants asked to perform 5 min day for 4 weeks on their dominant limb.
- Seated with ball under toes 2-4.
- Gripping motion with all toes.

Branthwaite, H., Grabtree, G., Chockalingam, N. and Greenhalgh, A., 2018. The Effect of Toe Flexion Exercises on Grip. Journal of the American Podiatric Medical Association, 108(5), pp.355-361.

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### Intrinsic Progression

Seated dome with lift and active ankle PF/DF

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### Intrinsic Progression- FDB

MTP joint flexion with resistance band at base of toe for flexor hallucis brevis and flexor digitorum brevis 5"x5


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### Intrinsic Progression

Dome with SL balance progressions:

- SL stance with glute activation and dome
- SL stance with Kettle bell transfer
- SL stance with hip flex/ext with glute activation
- Banded marching
- RDL
- RDL on ½ foam roller variations




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### Intrinsic Progression

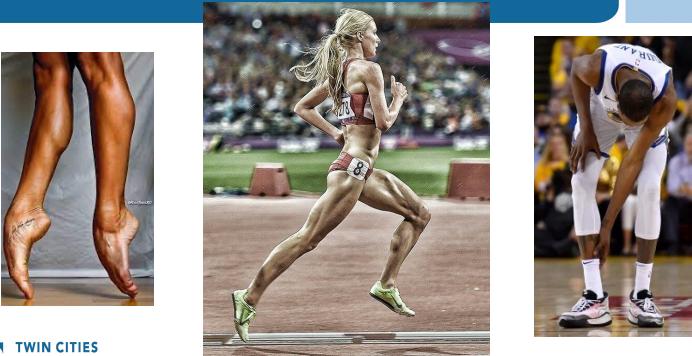
6"-12" box step downs 10x each

- landing leg long strong toes
- added rotator disc for top leg
- moved rotator disc to bottom leg
- added foam under working foot for unstable surface with eccentric focus



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### Triceps Surae Progressions

Gastroc and soleus strengthening

Diagnosis: Achilles repair, Partial Achilles tear, Conservative approach to Achilles tear, Calf strain, Plantaris rupture

Goal: full body weight single leg calf raises

Endurance testing: comparing side to side single leg



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### Calf raise normative data

DECADE OF LIFE	MALES	FEMALE
20	37	30
30	32	27
40	28	24
50	23	21
60	19	19
70	14	16
80	10	13

K. Hébert-Losier, C. Wessman, M. Alricsson, U. Svantesson, Updated reliability and normative values for the standing heel-rise test in healthy adults, Physiotherapy 103 (2017) 446–452.



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### Triceps Surae Progressions



#### Gastroc progression:

- PF with band
- Back against wall for small range calf raise already in PF
- Bent over DL standing
- Bent over SL iso (DL up)
- Bent over SL eccentric
- Bent over SL
- DL PF standing (consider ML wobble board for split weight cue)
- Pushup position at counter SL from towel rolls
- SL iso (DL up) in standing
- SL eccentric
- SL calf raises



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### Triceps Surae Progressions

#### Soleus progression:

- PF with band knee bent
- Seated calf raise (pushing into ground on the up and the down)
- Seated weighted
- Bent over DL soleus
- Bent over SL soleus
- Standing DL
- Standing SL



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### Triceps Surae Progressions


#### Complex and Combined Exercises


#### Phase 2 Ankle strength and control concepts:



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 MINNESOTA GYMNAST Sunisa Lee Becomes The First Hmong American To Win A Gold Medal

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### Thank you!

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 2021 Olympic Trials for Artistic Gymnastics

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