



CHRONIC ANKLE INSTABILITY

Eric M Magrum DPT OCS FAAOMPT

Orthopaedic Manual Physical Therapy Series
Charlottesville 2017-2018



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**** Subjective Asterisks Signs/Symptoms ****

- 34 yo real estate agent; 5 months s/p misstep at construction site with ® ankle PF/INV injury. Goals: return to softball, coach kids soccer, walk uneven terrain – work
- C/o: Anterolateral ankle pain, stiffness, feels “vulnerable”; intermittent sharp pain laterally with lateral mvts, rotation. Intermittent effusion anterior TC, posterior to lateral malleolus. Denies mechanical, Neurovascular sxs.
- PMHx: ® Ankle sprain 5+; HS tear ®.



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Chronic Ankle Instability

- Development of repetitive ankle sprain
- Persistent post injury symptoms
- “Giving Way”
- Recurrent Inversion injury

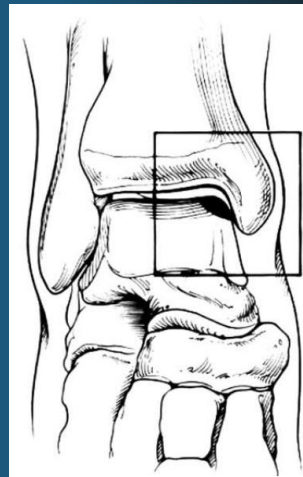


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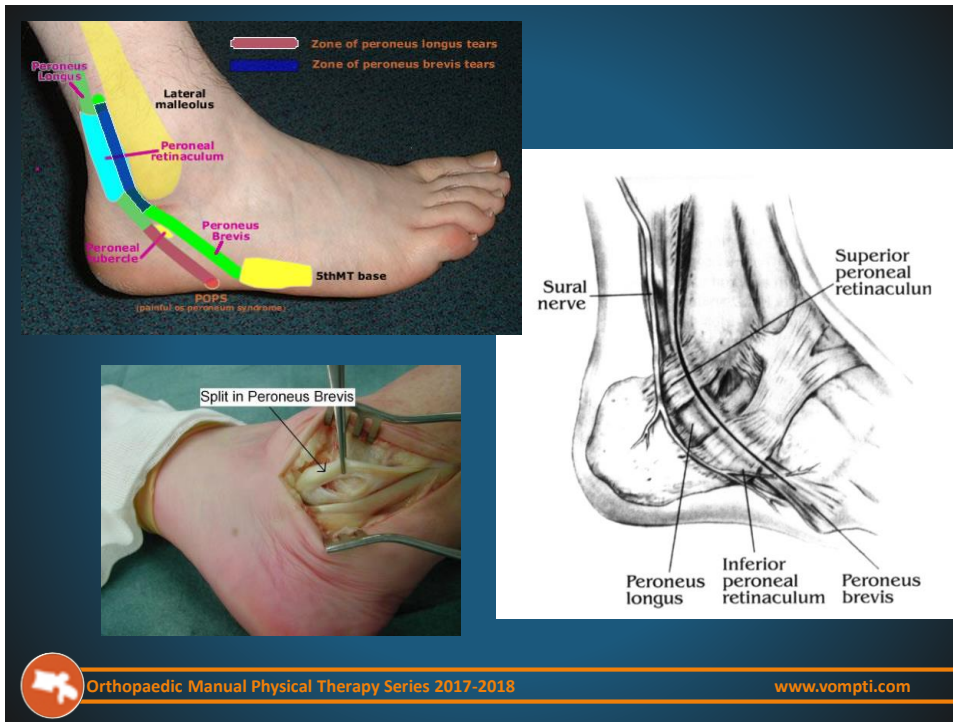
Differential List

- Peroneal Brevis Tearing - Longitudinal
- Peroneal Tenosynovitis
- Peroneal Tendon Subluxation
- OCD Lesion Talar Dome
- Ankle Impingement/Synovitis
- Retinacular Attenuation
- Syndesmosis Injury
- Medial/Deltoid Injury
- Lis Franc/Mid Foot Injury



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**** Physical Exam “Asterisks” Signs/Symptoms ****

- Effusion anterior aspect TC Medial>lateral aspect
- Rearfoot Varus
- Limited DF ROM
- TC post glide; STJ EVR hypo mobility
- Functional Screen:
 - Poor Single leg stance - Increased sway, lateral LOB.
 - Bilateral Squat: Limited TC DF with lateral ankle pain.
 - Lateral Hop: Pain, loss of balance lateral
- (+) Talar Tilt



CLINICAL PRACTICE GUIDELINES

ROBROY L. MARTIN, PT, PhD • TODD E. DAVENPORT, DPT • STEPHEN PAULSETH, DPT, MS
DANE K. WUKICH, MD • JOSEPH J. GODGES, DPT, MA

Ankle Stability and Movement Coordination Impairments: Ankle Ligament Sprains

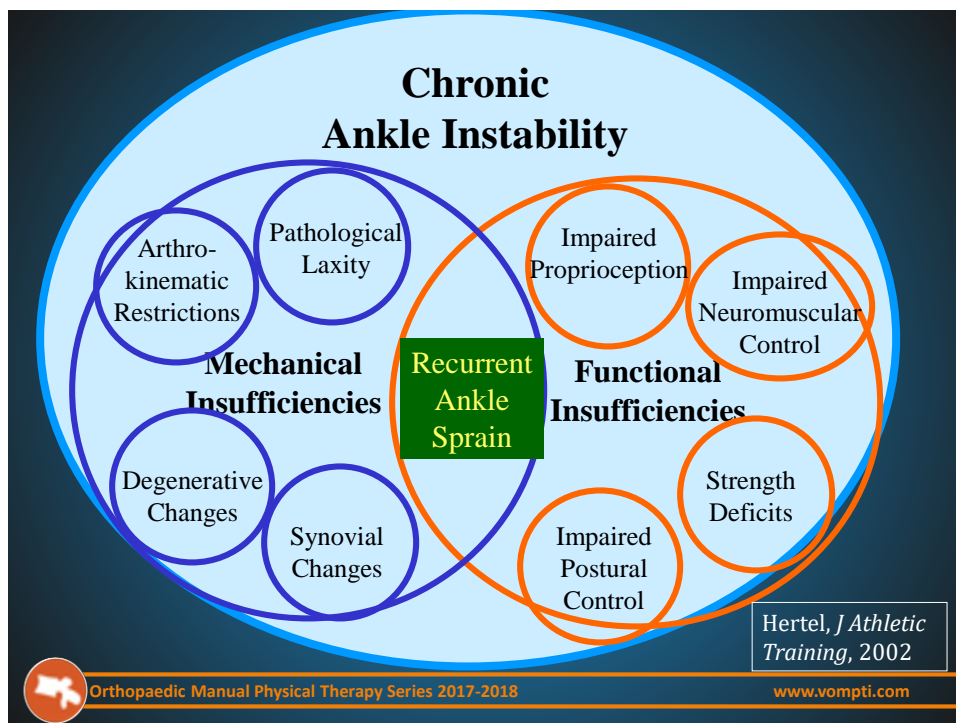
Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association

J Orthop Sports Phys Ther. 2013;43(9):A1-A40. doi:10.2519/jospt.2013.0305



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Functional and/or Mechanical Deficits

Functional

- Subjective report – frequent “giving way” with normal activity
- Neuromuscular deficits
- Proprioceptive deficits
- Strength deficits
- Postural control deficits

Mechanical

- Movement > physiological limit
- Pathologic laxity
- Arthrokinematic restrictions
- DJD
- Synovial changes



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Recovery From a First-Time Lateral Ankle Sprain and the Predictors of Chronic Ankle Instability

The American Journal of Sports Medicine, 2016

A Prospective Cohort Analysis

Predictive of CAI

- 2 Weeks
 - Inability to complete single drop landing and drop jump
- @ 6 months
 - Lower FAAM – ADLs
 - Decreased SEBT (post reach directions)



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CAI Comprehensive Rehab

Exercise Specificity

- Proprioception
- Neuromuscular control
- Strength
- Postural control



Manual Therapy

- Specific Joint restrictions

Education

- Feedback

Outcome Assessment



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Proprioception

Neural input to the CNS

• Mechanoreceptors

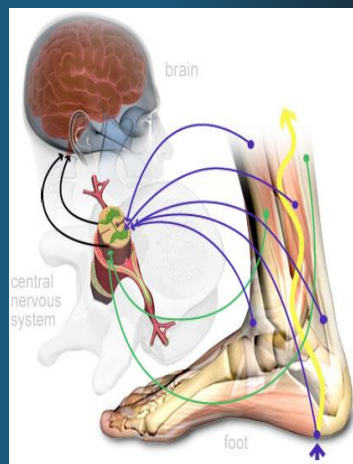
- Articular
- Myofascial

Muscle afferents

- Cutaneous

Kinesthesia

Joint Position Sense



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Proprioception Deficits

- **Decreased DF/EVR**
- Clearance in swing
- **Terminal Swing**
- Increased PF/INV
- Bilateral



- **Frontal plane > Sagittal plane JPS deficits**



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Treatment

Improve Joint Position Sense

Multi station Balance

Exercises

Strengthening – EVR/INV

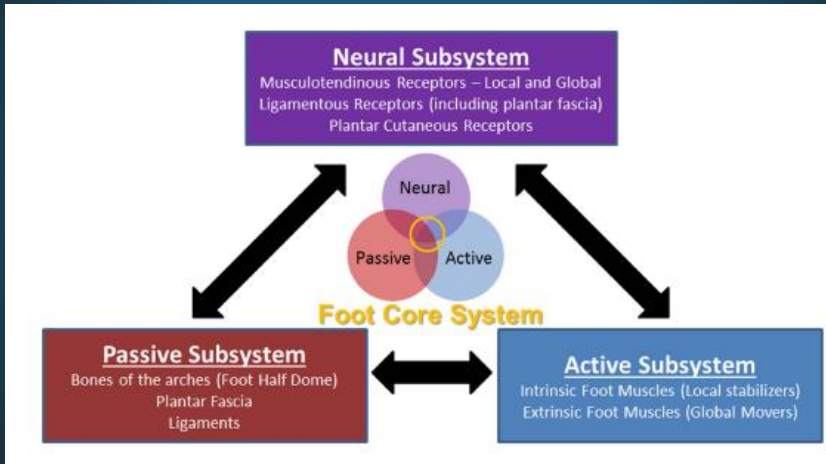


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The foot core system: a new paradigm for understanding intrinsic foot muscle function

Patrick O McKeon,¹ Jay Hertel,² Dennis Bramble,³ Irene Davis⁴

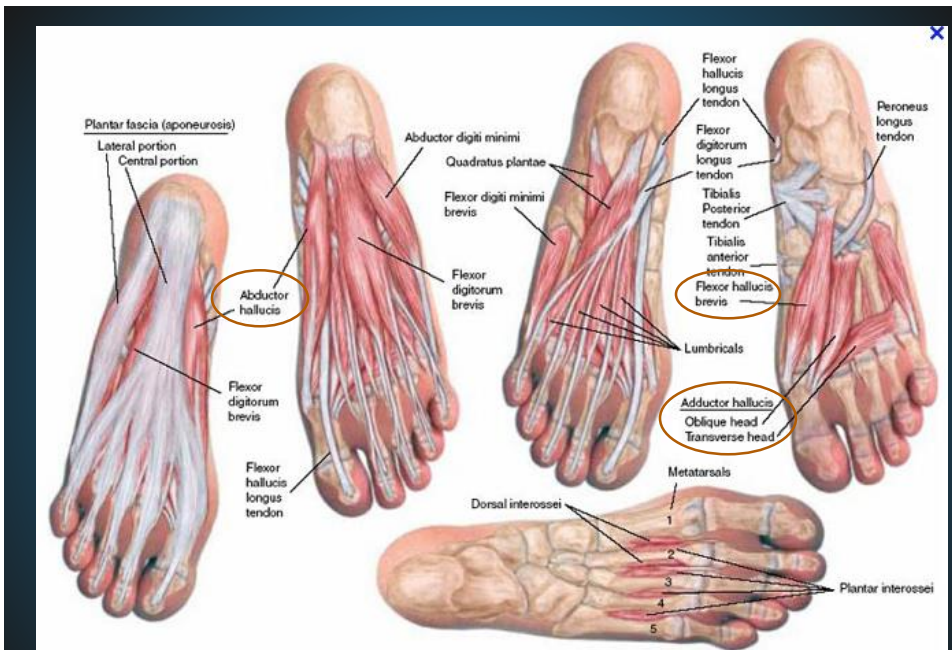


Br J Sports Med 2014



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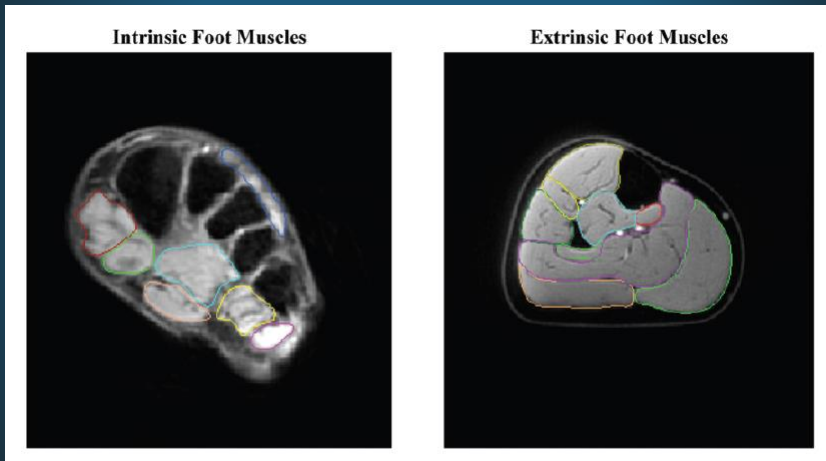
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Diminished Foot and Ankle Muscle Volumes in Young Adults With Chronic Ankle Instability



The Orthopaedic Journal of Sports Medicine, 4(6).



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Intrinsic Foot Muscle activation

“Short Foot”

- Drag Ball of big toe toward heel without toe flexion/clawing

Activation

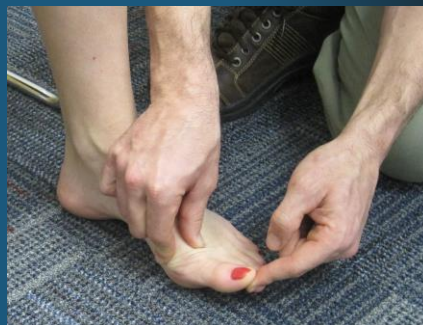
- Lift 5 toes (passive tension arch muscles) – relax toes maintain active tone in arch muscles

Dissociation

- Plant 1st Ray, lift 4 lateral toes” alternate

<->

Lift 1st Ray, keep 4 lateral toes stable



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Dorsiflexion deficit during jogging with chronic ankle instability

Lindsay K. Drewes^{a,*}, Patrick O. McKeon^a, D. Casey Kerrigan^b, Jay Hertel^a

Journal of Science and Medicine in Sport 12 (2009) 685–687

Altered Ankle Kinematics and Shank-Rear-Foot Coupling in Those With Chronic Ankle Instability

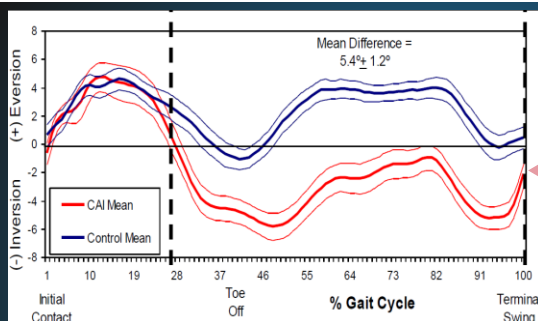
Lindsay K. Drewes, Patrick O. McKeon, Gabriele Paolini, Patrick Riley, D. Casey Kerrigan, Christopher D. Ingersoll, and Jay Hertel

Journal of Sport Rehabilitation, 2009, 18, 375-388

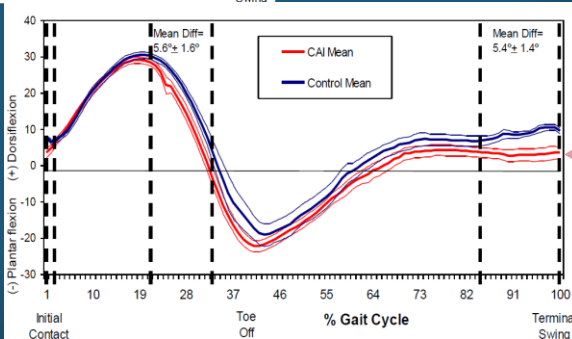


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CAI: Increased PF/INV at terminal swing



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Summary of Kinematic Differences

- **CAI** group significantly more inverted than **controls** and **copers** during late stance and all of swing
- **CAI** and **coper** groups significantly more plantar flexed than **controls** during late stance, early swing, late swing, and at initial contact



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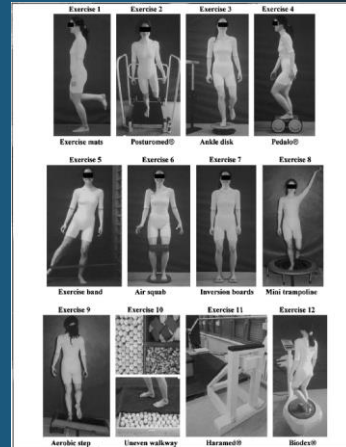


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A multi-station proprioceptive exercise program in patients with ankle instability

Results: Significant improvement in joint position sense and postural sway as well as significant changes in muscle reaction times

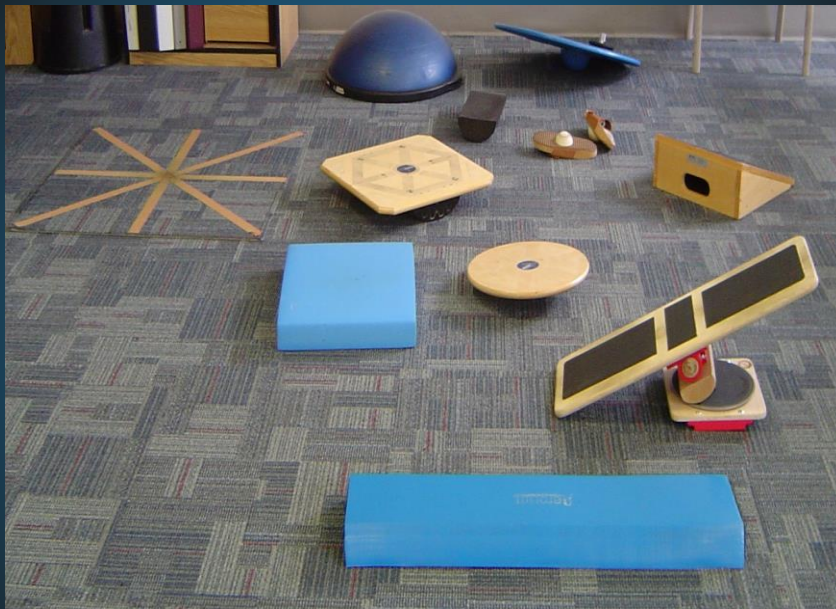


Med Sci Sports Exerc. 2001



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Therapeutic interventions for improving self-reported function in patients with chronic ankle instability: a systematic review

Kyle B Kosik, Ryan S McCann, Masafumi Terada and Phillip A Gribble

Br J Sports Med published online November 2, 2016

How might it impact on clinical practice in the future?

- ▶ Balance training is the most consistent therapeutic intervention for improving self-reported function in patients with CAI.
- ▶ Majority of the multimodal rehabilitation programmes provided favourable outcomes; however, further evidence is needed to verify these findings.
- ▶ Limited evidence was found for the use of other therapeutic interventions targeting strength deficits and sensory alterations associated with CAI.



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Neuromuscular Deficits

Unconscious activation of dynamic

restraints occurring **in preparation** for

and in response to joint **motion and**

loading for the purpose of maintaining

and restoring functional **stability**

Riemann BL J Athl Train 2002

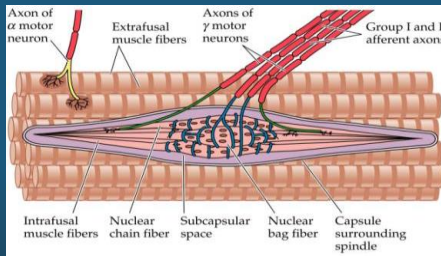


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? Feed forward > Feed back

- Ligament **mechanoreceptors** do **not** facilitate a muscle reaction **fast enough** to protect from an inversion sprain
- Central Motor programming deficit
- **Arthrogenic Muscular Inhibition**



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Peroneal Reaction Time following Ankle Sprain: A Systematic Review and Meta-analysis

- **Previous Ankle Sprain**
 - **Impaired Peroneal Reaction Time**
- **Chronic Ankle Instability**
 - **Delayed Peroneal Reaction time compared to uninvolved side**



Medicine & Science in Sports & Exercise, Publish Ahead of Print



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Neuromuscular Re-Education

Unconscious Incompetence



Conscious Incompetence



Conscious Competence



Unconscious Competence



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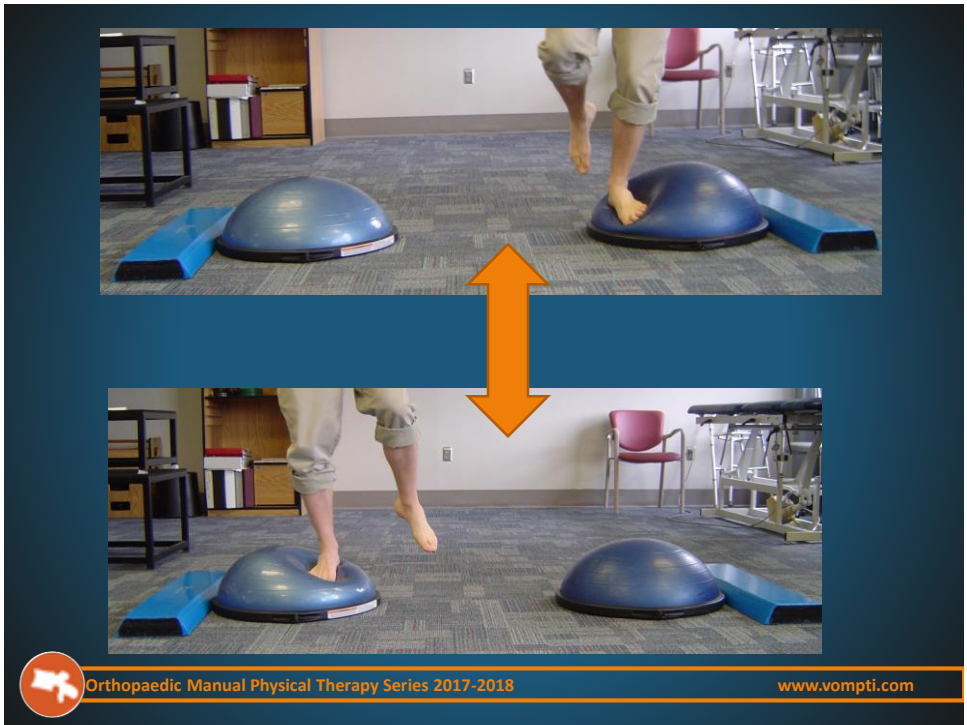
Neuromuscular Control

- **Delayed/Inadequate Response**
- **Exercise Prescription**
 - Unexpected perturbations
 - Landing mechanics
 - Unstable surfaces
 - Feedback



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Strengthening - ? Controversy

- Evertors (increased PF/INV – terminal swing)
- Concentric Invertors = Improved JPS
- Co Contraction
- Closed Kinetic Chain
- Proximal – Hip/Gluteals
- Foot Intrinsic
- Eccentric Invertors
 - Displace COM – laterally
- **Functional – Sport Specific**



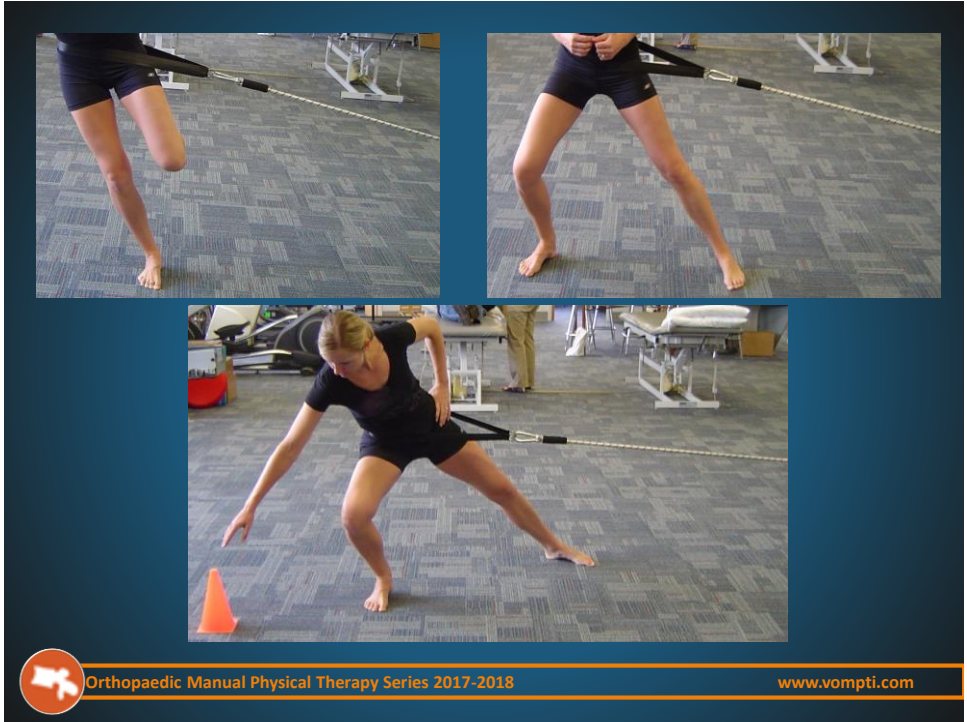
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Arthrogenic Muscle Response of the Quadriceps and Hamstrings With Chronic Ankle Instability

Edward J. Sedory, MEd, ATC, EMT; Eric D. McVey, MEd, ATC;
Kevin M. Cross, MEd, ATC, PT; Christopher D. Ingersoll, PhD, ATC, FACSM;
Jay Hertel, PhD, ATC, FACSM

Key Points

- Differences in motoneuron pool excitability of the quadriceps and hamstrings muscles were found between those subjects with chronic ankle instability and control subjects.
- Proximal deficits in motor control should be considered when assessing and treating patients with lateral ankle sprains and chronic ankle instability.

Journal of Athletic Training 2007;42(3):355-360



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Ankle Inversion Injury and Hypermobility: Effect on Hip and Ankle Muscle Electromyography Onset Latency

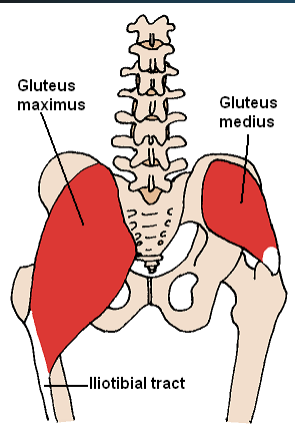
Conclusions: These data suggest that there is decreased latency of hip muscle activation after ankle inversion in the hypermobile population. In treating ankle instability, clinicians must decide to address the altered hip muscle recruitment pattern or accept this recruitment pattern as an injury-adaptive strategy and thus accept unknown long-term consequences of premature muscle activation (ie, possible articular predisposition to degenerative changes, altered joint reaction forces, and muscle imbalances).

Arch Phys Med Rehabil Vol 76, December 1995





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Gluteus maximus
Gluteus medius
Iliotibial tract



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A comparison of electromyography of gluteus medius and maximus in subjects with and without chronic ankle instability during two functional exercises

Clinical message

Gmax activation was lower in the CAI group compared to those with healthy ankles at the point of maximum excursion during a rotational squat exercise.

In the healthy group, the rotational squat demonstrated significantly higher Gmax activation compared to the rotational lunge exercise.

Neuromuscular changes at the hip continue to be documented in those with CAI compared to healthy subjects.

Clinicians looking for exercises which stimulate high Gmax activation may want to consider implementing the rotational squat exercise.



Physical Therapy in Sport (2012).

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Star Excursion (Y) Balance Test



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Postural Control

- Involves Somatosensory, Visual, and Vestibular systems to remain upright

- Eyes Closed
- Unstable surfaces
- Progressive
- Dynamic
- Sport Specific



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Increased Visual Use in Chronic Ankle Instability: A Meta-analysis

- **CAI patients have altered sensory organization strategies**
- **Increased reliance on visual information (Up regulation)**
- **Decreased somatosensory information from ankle (Down regulation)**
- **Resultant motor control deficit**

Medicine & Science in Sports & Exercise 2016



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Balance Training Improves Function and Postural Control in Those with Chronic Ankle Instability

Med. Sci. Sports Exerc., Vol. 40, No. 10, pp. 1810-1819, 2008.

PATRICK O. MCKEON¹, CHRISTOPHER D. INGERSOLL², D. CASEY KERRIGAN², ETHAN SALIBA², BRADFORD C. BENNETT², and JAY HERTEL²

- **Progressive Balance Program**
 - Dynamic stabilization
 - Perturbations
 - Unpredictable changes in direction
 - Landing from Hop
 - Dynamic reaching - SEBT
- **Improved static stabilization: TTb - eyes closed**
- **Improved dynamic stabilization : SEBT**
- **Improved self reported functional status : (FADI)**



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Single-Limb Stance Activities

Participants performed three repetitions of single-limb stance activities. Each activity (eyes open and eyes closed) had seven levels of difficulty.

1. Arms out on hard floor for 30 s
2. Arms across chest on hard floor for 30 s
3. Arms across chest on hard floor for 60 s
4. Arms out on foam pad for 30 s
5. Arms across chest for 30 s on foam pad
6. Arms across chest for 60 s on foam pad
7. Arms across chest for 90 s on foam pad



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Single-Limb Hops to Stabilization

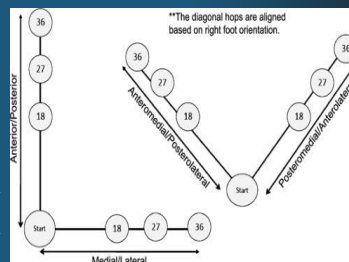
10 hops in each direction

Hop from the starting position to the target position (18, 27, or 36 inches).

After stabilizing balance in a single-limb stance, participants hopped in the exact opposite direction back to the starting position and stabilized in the single-limb stance.

Four directions of hops:

- Anterior/Posterior
- Medial/Lateral
- Antero lateral/Posterior medial
- Antero medial/Posterior lateral

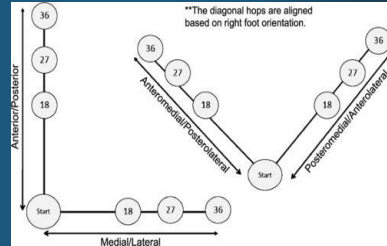


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Hop to Stabilization and Reach

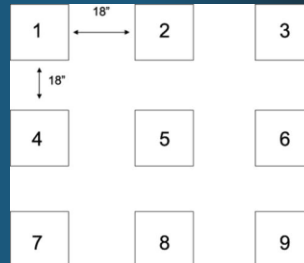
- Hop → After stabilization in the single-limb stance, participants had to reach back to the starting position
- Then they hopped back to the starting position and reached to the target position.

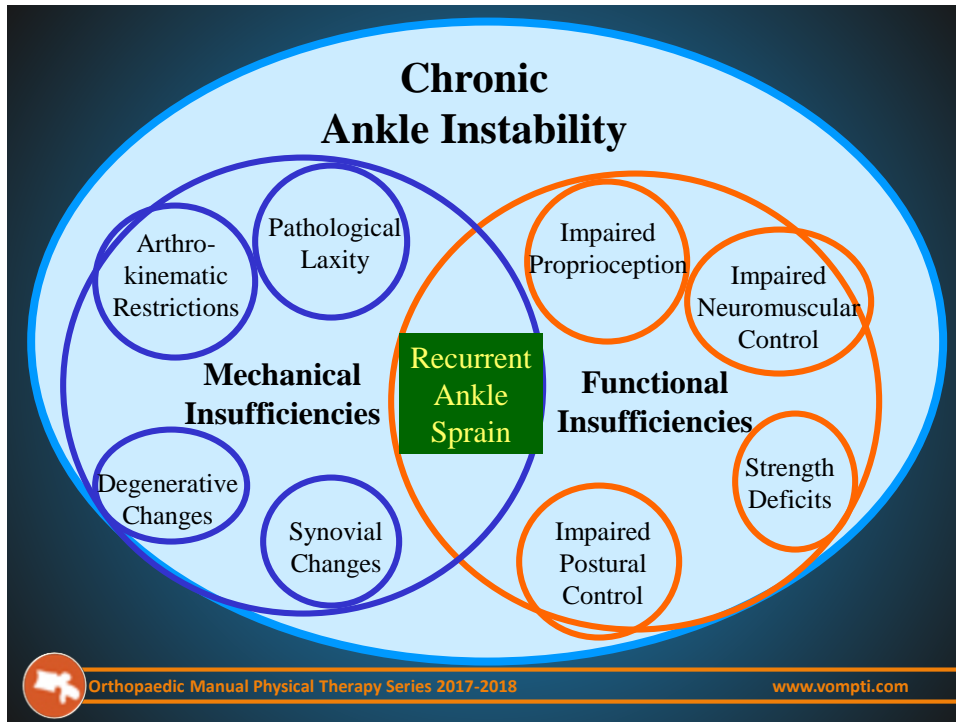


Unanticipated Hop to Stabilization

Numbers displayed to participants.

- Corresponding to a target position to which they would hop.
- Hop to stabilization - participants were allowed to use any combination of hops (AP, ML, AM/PL, or AL/PM) they desired to accomplish the goal of getting through the sequence error-free.





Changes at the Joint

- Increased laxity
- Altered joint alignment
– TC, Distal tib fib
- Impaired arthrokinematics
- Sensorimotor changes
- Increased load on the joint

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ARTHROKINEMATIC IMPAIRMENTS

- Hypo mobility
- Distal Tibia fibular Joint Positional Fault
- Talar Positional Fault
- Limited Posterior Talar Glide



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The efficacy of manual joint mobilisation/ manipulation in treatment of lateral ankle sprains: a systematic review

Br J Sports Med 2014.

Janice K Loudon,¹ Michael P Reiman,² Jonathan Sylvain²

What this study adds

- ▶ This is the first study investigating **joint mobilisation/ manipulation** as an **isolated intervention** for the treatment of acute and subacute/chronic ankle sprains.
- ▶ Joint mobilisation/manipulation techniques acutely **improve ankle dorsiflexion ROM** and pain in all investigated groups, as well as **improved function** in the subacute/chronic participants.
- ▶ The application of manual joint mobilisation/manipulation to appropriate participants presenting with acute and subacute/ chronic ankle sprains appears to result in no detrimental effects.



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Ankle Stability and Movement Coordination Impairments: Ankle Ligament Sprains

INTERVENTION - PROGRESSIVE LOADING/SENSORIMOTOR TRAINING PHASE - MANUAL THERAPY: Clinicians should include manual therapy procedures, such as graded joint mobilizations, manipulations, and non-weight-bearing and weight-bearing mobilization with movement, to improve ankle dorsiflexion, proprioception, and weight-bearing tolerance in patients recovering from a lateral ankle sprain. (Recommendation based on strong evidence)



Anterior positional fault of the fibula after sub-acute lateral ankle sprains

Tricia J. Hubbard^{a,*}, Jay Hertel^b

5. Conclusion

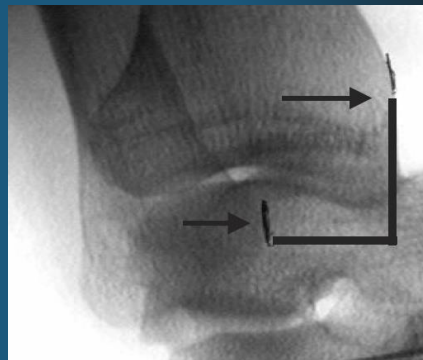
We identified an anteriorly positioned distal fibula in individuals with sub-acute LAS. We do not currently know if altered fibular position was a predisposing factor to injury. It appears that swelling maintains fibular displacement acutely.



Fibular Position in Individuals With Self-Reported Chronic Ankle Instability

CONCLUSION

We identified an anteriorly positioned fibula in individuals with CAI. Further research is necessary to examine the clinical importance of anterior fibular position in comparison to other potential contributors to CAI, and to identify the minimum amount of positional fault needed to cause ankle joint dysfunction.



J Orthop Sports Phys Ther • Volume 36 • Number 1 • January 2006



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Talar Positional Fault in Persons With Chronic Ankle Instability

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

- Anterior positional fault of the **Talus** may be present in individuals with CAI



Arch Phys Med Rehabil Vol 91, August 2010

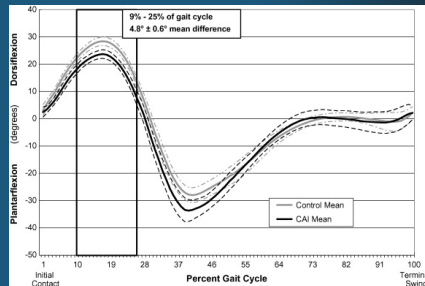


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Dorsiflexion deficit during jogging with chronic ankle instability

- **Limited ankle dorsiflexion ROM during midstance**
- **Limited dorsiflexion ROM during gait among individuals with CAI may be a risk factor for recurrent ankle sprains**



Journal of Science and Medicine in Sport 12 (2009) 685–687



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Initial Changes in Posterior Talar Glide and Dorsiflexion of the Ankle After Mobilization With Movement in Individuals With Recurrent Ankle Sprain

J Orthop Sports Phys Ther • Volume 36 • Number 7 • July 2006



FIGURE 4. Non-weight-bearing mobilization with movement. The therapist glides the talus anteroposteriorly against a tibia that is fixed by the treatment table, while the patient actively dorsiflexes the ankle to end of available pain-free dorsiflexion.



FIGURE 3. Weight-bearing mobilization with movement. The belt applies a posteroanterior force to the distal tibia, while the talus and foot remain stationary on the table and the patient actively goes to end of pain-free range dorsiflexion.



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Joint Mobilization Improves Spatiotemporal Postural Control and Range of Motion in Those with Chronic Ankle Instability J Orthop Res 29:326–332, 2011

Joint mobilization was associated with:

- Greater DF ROM*
- TTB anterior-posterior direction*
- Posterior Talar displacement
- Mean of TTB medial-lateral

This indicates that joint mobilization treatment has **mechanical and functional benefits** for addressing impairments in **sensorimotor function and arthrokinematic restrictions** commonly experienced by **individuals with CAI**



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Predicting Short-Term Response to Thrust and Nonthrust Manipulation and Exercise in Patients Post Inversion Ankle Sprain

- Development of CPR to predict success with Manual Therapy + Exercise
- $\frac{3}{4}$ Variables predicted 95% likelihood for success
 - Worse with standing
 - Worse in the evening
 - Navicular drop > 5mm
 - Hypo mobile Distal Tib-Fib

JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 39 | NUMBER 3 | MARCH 2009



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Proximal Tibiofibular Joint – Anterior Mob/Manipulation

- Grasp posterior aspect of fibular head with 2nd MCP
- ER tibia, Flex knee to barrier with opposite hand on distal tibia
- High velocity, low amplitude thrust – direction of force toward ipsilateral buttock



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ERIC M. MAGRUM, DPT, OCS, FAAOMPT¹ • CHRISTOPHER D. INGERSOLL, PhD, ATC, FACSM, FNATA⁴ • JAY HERTEL, PhD, ATC, FACSM, FNATA⁵
FEBRUARY 2012 | VOLUME 42 | NUMBER 2 | JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY

Effects of a Proximal or Distal Tibiofibular Joint Manipulation on Ankle Range of Motion and Functional Outcomes in Individuals With Chronic Ankle Instability

KEY POINTS

FINDINGS: Neither the proximal nor distal tibiofibular joint manipulation group demonstrated improvements in functional and patient-oriented outcomes beyond those of a control group that did not receive an intervention.



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Proximal TibFib Posterior Mobilization/Manipulation

- Decreased Post Medial glide
- Stabilize medially to prevent valgus
- Stabilize tibia medially
- Pisiform on fibular head
- Mob/Thrust down to table (Post Med)



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Proximal TibFib Anterior Mobilization/Manipulation

- Decreased Ant Lateral glide
- Opposite side so
manipulating hand is
in line with axis of joint
- Stabilize with inside hand
- Pisiform over fibular head
- Mob/Manip (**Anteriolateral direction**)



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Immediate effects of a tibiofibular joint manipulation on lower extremity H-reflex measurements in individuals with chronic ankle instability

Terry L. Grindstaff^{a,*}, James R. Beazell^b, Lindsay D. Sauer^c, Eric M. Magrum^b, Christopher D. Ingersoll^d, Jay Hertel^e

- Individuals with CAI demonstrated changes in **soleus** H/M ratio without changes in **fibularis longus** activation following **Distal Tibiofibular joint manipulation**
- **Proximal tibiofibular joint manipulation did not have an effect on muscle activation**

J Electromyogr Kinesiol. 2011



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Distal Tib/Fib Posterior Mobilization/Manipulation

- Distal LE edge of table, stabilize foot at end ROM DF
- Stabilize distal Tibia with inside hand
- Thenar eminence contact lateral malleolus
- Anterior to Posterior force through weight shift



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Distal Tibiofibular Joint – Functional Posterior Mobilization

Clinician stabilizes the anterior aspect of the distal tibia.

Opposite hand grasps the **anterior aspect of the distal fibula** with the Thenar eminence

As the patient translates the knee forward, the **distal fibula** is translated in an **anterior-to-posterior** direction



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Mulligan Distal TibFib Taping



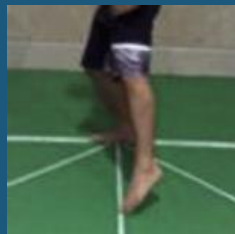
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Immediate effects of Mulligan's fibular repositioning taping on postural control in athletes with and without chronic ankle instability

5. Conclusion

This investigation was designed to investigate the use of a specific ankle taping (FRT) technique in athletes with CAI and compared them to healthy athletes during a dynamic balance task. Our results revealed that Mulligan's fibular repositioning taping significantly improved acute postural control in athletes with CAI and healthy athletes. Although we only examined acute effects of



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Physical Therapy in Sport 16 (2015)

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Talocrural Distraction Mobilization/Manipulation

- Grasp dorsum of the foot with interlaced fingers, Stabilize plantar aspect with thumbs
- DF, pronate to barrier
- Long axis distraction
- Mob/Manipulation - Caudal



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Talocrural Posterior Mobilization/Manipulation

- Contact anterior talus with thumbs/web space
- DF, pronate/supinate to barrier; Stabilize with thigh
- Anterior to posterior force to talus
- Mob/Manipulation
- MWM - Patient actively pulls into DF



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The Effectiveness of Mobilization With Movement at Improving Dorsiflexion After Ankle Sprain

Matthew C. Hoch and Patrick O. McKeon

Clinical Bottom Line

There is moderate evidence supporting the use of talocrural MWM for improving dorsiflexion in those with a history of ankle sprain.

Strength of Recommendation: There is level B evidence that a single talocrural MWM treatment improves dorsiflexion in those with a history of ankle sprain. Although the effect sizes displayed a trend in favor of MWM, caution should be used in interpreting these findings because the effect-size confidence intervals cross zero for all 3 investigations, suggesting that further investigation is warranted.

Journal of Sport Rehabilitation, 2010, 19, 226-232



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Posterior Talar Mobilization With Movement

Clinician contacts the anterior aspect of the talus with thumbs

Anterior-to-posterior directed force is maintained while patient lunges forward

Adjust lunge direction (medial, lateral) and force on talus angulation to engage specific barrier



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- Contact **anterior** aspect **talus** with web space 1-2nd digits
- Mobilization belt around posterior distal Tib-fib and clinicians' buttocks
- Patient lunge to engage DF barrier
- **Anterior** → **Posterior** mobilization at **talus**; **Posterior** → **Anterior** mobilization **distal tibia** through clinician weight shift

Functional Talocrural Posterior Mobilization



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STJ Distraction



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Medial Tilt – Eversion Mobilization/Manipulation STJ

- Grasp calcaneus medially – thumb/2nd MCP (inside arm); Outside hand – navicular (thumb, calcaneus distally – 2nd MCP)
- Stabilize Fibula laterally with 2nd MCP
- Popliteal region into clinician's iliac crest
- Distraction – Lean back
- **Ulnar deviation – medial tilt** (fulcrum with hypothenar on tibia)



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Lateral Tilt – Inversion Mobilization/Manipulation STJ

- Grasp calcaneus medially – thumb/2nd MCP (inside arm); Outside hand – navicular (thumb, calcaneus distally – 2nd MCP)
- Stabilize Tibia medially with 2nd MCP
- Popliteal region into clinician's iliac crest
- Distraction – Lean back
- **Radial deviation – lateral tilt** (fulcrum with hypothenar on tibia)



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STJ Medial/Lateral Glides



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Medial Column Mid foot Mobilization

Navicular on Talus

- Medial -Lateral Rotation
- Plantar-Dorsal Glide



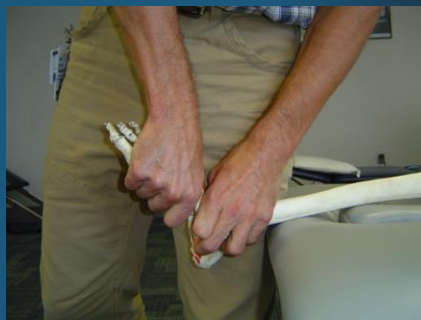
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Medial Column Mid foot Mobilization

Medial Cuneiform on Navicular

- Medial -Lateral Rotation
- Plantar-Dorsal Glide



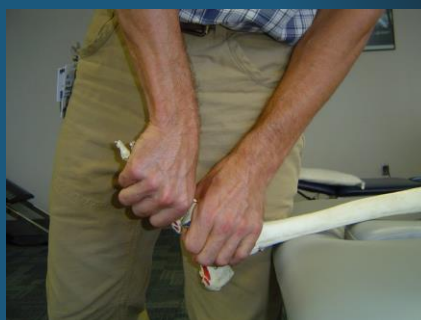
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Medial Column Mid foot Mobilization

First MT on Medial Cuneiform

- Medial -Lateral Rotation
- Plantar-Dorsal Glide



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Plantar Mid Foot Mobilization/Manipulation



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Calcaneocuboid Joint Techniques

- Cuboid may present plantar positioned joint dysfunction and with medial rotation in inversion sprains
 - Overactivation of PL pulling on a loose packed cuboid
 - Cuboid dorsal glide hypomobility
 - **Less often will present dorsally positioned joint dysfunction**
 - Loss of plantar mobility and loss of Eversion



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Plantar Cuboid Mobilization/Manipulation



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Dorsal Cuboid Whip Manipulation –Prone



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Dorsiflexion Self Mobilization



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Summary

- **Exercise Prescription → Specificity**
 - **Proprioception**
 - Multistation Balance Exercises
 - DF/EVR at initial contact
 - **Neuromuscular Re**
 - Feed forward > Feed back
 - **Strengthening**
 - Closed Kinetic Chain (Invertors, Evertors, Proximal)
 - **Postural Control**
 - Eyes closed, Dynamic
- **Manual Therapy → Specificity**
 - Restore TC DF
 - Normal Arthrokinematics



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? Questions ?



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