Effect of Mulligan's Mobilisation with Movement on Ankle Dorsiflexion: An Optical Motion Analysis and Fluroscopy Case Report

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Lateral ankle injury

- Large range of injury:
  - Inversion sprains
  - Fracture
  - Fracture /dislocation
- Common in sports activities
- Particularly prevalent in jump-landing sports
  - Basketball
  - Volleyball

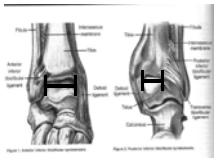
Ankle inversion sprains

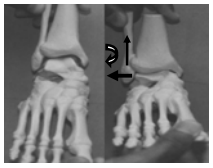
- **Recurrence rates as high as 80%** *Denegar C, Journal Athletic Training, 2002*
- **Previous ankle injury is a strong predictor of re-injury** *Beynnon B, Journal Athletic Training, 2002*
- **Common clinical finding of loss of ankle dorsiflexion post inversion sprain** *Hubbard T, Hertel J, JOSPT, 2006*
- **Persistent loss of ankle dorsiflexion post-injury significantly increases risk of re-injury in:**
  - **army recruits** *Pope R, AJP, 1998*
  - **children** *Tabrizi P, JBJS, 2000*

Ankle dorsiflexion biomechanics

- Talus wider anterior than posterior
- During dorsiflexion talus glides posteriorly
- Talus drives "wedge" between maleolii
- Results in relative fibular abduction, external rotation and approximation relative to tibia

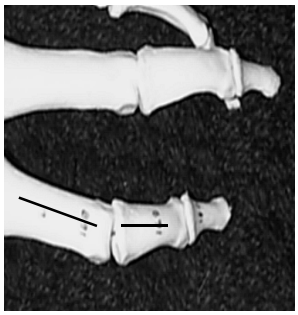
Kapandji Physiology of the Joints, Vol. 2, Lower Limb





MWM - Mulligan's Theory Bony positional faults

- Following injury or strain a joint may assume a slightly abnormal position.
- Mechanical blocks' from inert tissues. *(Lewit 85)*
- Afferent joint discharge and reflex muscle splinting. *(Schaible & Grubb 93)*
- Movement restrictions and pain results.



Inversion sprain & positional fault sequelea

- The plantar-flexion/inversion exerts a tensile force through the ATFL of the ankle
- Resulting in a local ligament injury and an additional anterior/ inferior moment arm to the fibula
- The fibula becomes fixated in an anterior position do to entrapped intra-articular joint meniscoids *(Mercer & Rivett 2003)* &/or swelling *(Hubbard 2008)*
- The slacked ATFL now allows the talus to sublux anteriorly resulting in premature anterior talo-tibial impingement, anterior ankle pain and loss of dorsiflexion. (*Vincenzino 2006)*

Supporting research

- **MRI evaluation**
  Merlin, D, McEwan I, Thom J., The Accelerated Rehabilitation of the Injured Athlete, Congress Bolonga 2005.
- **Clinical evaluation**
  Vincenzino B., Branjerdporn M., Et. Al. JOSPT Vol 36 No 7 July 2006.
- **Fluoroscopic evaluation**
  Hubbard, T., Hertel J., Sherbondy P., JOSPT 36 (1) Jan. 2006.
- Hubbard,T., Hertel J., Manual Therapy 13 2008.

MWM Ankle Dorsi-flexion

- Mobilisation
  - Anterior glide distal tibia, talus fixated
- Movement
  - Patient lunges forward
- Tips
  - Progress from non to partial to full W/B
  - Track with dynamic treatment plane

QuickTime™ and a Sorenson Video 3 decompressor are needed to see this picture.

Supporting research

- Vincenzino, et.al., (2001), 2001: A Sports Odyssey: Challenging controversies & change, Australian Conference of Science and Medicine, C. Goodman (Ed.).
- Collins, N. et.al., (2004), Manual Therapy, No 9.
- Vincenzino, et.al., (2006), JOSPT, Vol 36, No 7.
- Reid, et.al., (2007), Physiotherapy Canada, Vol 59, No. 3.
- **Previous research outcome measures of dorsiflexion:**
  - **Non-weight bearing**
  - **Weight-bearing**

Non weight bearing measurement

- **Lidcombe template method**
- Reliable
  - Mosely, Adams, Measurement of passive ankle dorsiflexion: procedure and reliability, AJP, 1991, 37(3).
- Fails to demonstrate functional deficits or improvements pre to post- treatment
  (Vincenzino 2001, 2006)

Weight bearing measures

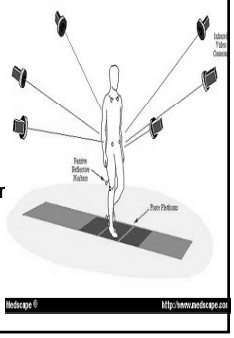
- **Wall lunge method**
- Reliable
  Bennell et. al. Intra-rater and inter-rater reliability of a weight bearing lunge measure of ankle dorsiflexion, AJP, 1998, 44(3).
- Demonstrates movement deficits and post treatment gains
- However -
  Do the measured gains achieved translate into functional improvements?

Study goals

- To objectively quantify the effects of Mulligan's mobilization with movement on ankle dorsiflexion during functional tasks
  - Gait
  - Squatting
  - Jump-down landing
- To observe the effects of MWM on ankle kinematics

Three dimensional optical motion analysis

- Wolfe Orthopaedic Biomechanics Laboratory
- University of Western Ontario, London Ontario, Canada
- 22 passive reflective markers affixed to standardized points on trunk and limbs
- 8 high speed digital cameras fitted with light emitting diode rings
- Optical motion capture at 60 frames per second analysis
- *X* and *Y* coordinates calculated to the centroid of each marker
- 3D reconstruction from 2D coordinates

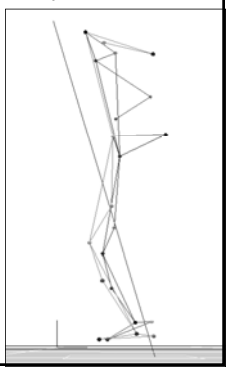


Case study Subject

- 38 y/o female graduate student
- 2 year history of recurrent lateral ankle sprains
- Pre-study screen revealed a 6 cm unilateral deficit in pain-free wall lunge
- Reported pain was located at anterior ankle
- No recent sprain or treatment (3 months)
- Naïve to Mulligan concept

Pre and Post Intervention Optical Motion Analysis

- **Subject performed 5 repetitions of:**
- Normal pace gait over 20 meter distance
- Full pain-free squat with feet shoulder width apart
- Jump down - land from 46 cm height fully absorbing the landing



Intervention

- Mulligan recommends:
- 3 sets of 10 repetitions of Mulligan's MWM for dorsiflexion in closed kinetic chain

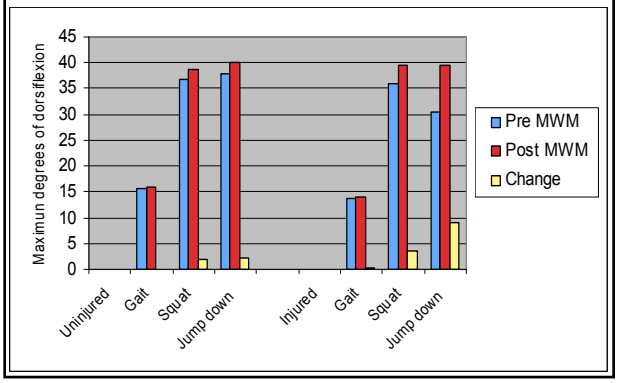
MWM mobilisation force standardization

- Mulligan provides no specific mobilisation force recommendations other than "pain - free"
- Mclean (Clinical Biomechanics, 2002) reported minimal force required to achieve hypoalgesia in lateral epicondylalgia of 1.9 N/cm
- Reid (Phys Can,2007) standardized MWM mobilisation force with biofeedback pressure gauge at 200 mmHg
- **Study parameters**
  Mobilisation force standardized to 8 N/cm using calibrated in-line force gauge

Optical Motion Analysis Results

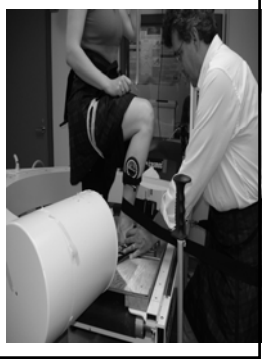
- Subsequent to the MWM
- Dorsi-flexion on the involved limb increased:
  - 3.54 degres during squatting
  - 9.12 degrees landing from a jump
- Changes during walking and changes in the uninvolved limb during all tasks were all ≤ 2.16 degrees.

Optical Motion Analysis Results



Fluoroscopic Analysis

- Performed on subsequent day
- 5 repetitions of dorsi flexion with real time fluoroscopy were performed:
  - Before MWM
  - During MWM
  - Following MWM
- Foot fixation plate used to standardize position
- Bubble goniometer used to standardize movement from neutral
- In-line force gauge used to standardize mobilisation force



Fluoroscopic analysis results

- Fluoroscopy demonstrated:
- Marked impingement of the anterior tibia onto the neck of the talus at end-range dorsi-flexion
- Substantial talo-navicular translation and posterior talo-calcaneal joint gapping prior to, during and following the MWM.
- Minimal translatoric gliding was observed in the tibio-talar joint during or subsequent to the MWM procedure.

Conclusions and further research recommendations

- Mulligan's Mobilisations with Movement can substantially increase ankle dorsiflexion in functional activities including full squatting and jump-down landing activities
- Further fluoroscopic research including radio-stereometric analysis (RSA) should be conducted to assess the biomechanical effects of MWM's on instantaneous axes of rotation and joint kinematics.
- Fluroscopy should be conducted prior to and immediately after MWM
- Subsequent re-assessments should be conducted prior to re-application of MWM

Thanks to:

Body Mechanics PHYSIOTHERAPY
Experienced Physiotherapy Care

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