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%
- Previous ankle injury is a strong predictor of re-injury
- 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
  - Children

Ankle dorsiflexion biomechanics

- Talus wider anterior than posterior
- During dorsiflexion talus glides posteriorly
- Talus drives “wedge” between maleoli
- 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 due 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**
- **Clinical evaluation**
- **Fluoroscopic evaluation**

**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

**Non weight bearing measurement**

- **Lidcombe template method**
- Reliable
  - Fails to demonstrate functional deficits or improvements pre to post- treatment (Vincenzino 2001, 2006)

**Weight bearing measures**

- **Wall lunge method**
  - Reliable
  - 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-fexion on the involved limb increased:
  - 3.54 degrees during squatting
  - 9.12 degrees landing from a jump
- Changes during walking and changes in the uninjured limb during all tasks were all ≤ 2.16 degrees.

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 tibiotalar 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.
- Fluoroscopy should be conducted prior to and immediately after MWM
- Subsequent re-assessments should be conducted prior to re-application of MWM

Thanks to: