Professores Titulares: Prof. Dr. Flávio Faloppa  
Prof. Dr. Akira Ishida  
Prof. Dr. Moisés Cohen  
Prof. Dr. Eduardo Barros Puertas  
Prof. Dr. Reynaldo Jesus Garcia

Chefe do Departamento: Prof. Dr. Eduardo Barros Puertas
Medial Collateral Ligament Injuries
Clinical relevant biomechanics and diagnosis

Dr. Gustavo Arliani
Chief of Sports Traumatology Center – Federal University of São Paulo/Brazil
Why MCL is important?

MCL is the most commonly injured component of the knee
42% of knees with ligamentous injuries
74,000 injuries per year

MCL is overlooked when compared to the lateral and central structures

MCL is the Primary static stabilizer to valgus motion

Median time loss of 30 days after injury

An anatomical three-dimensional study of the posteromedial corner of the knee.
MCL Biomechanics

Anatomy and Biomechanics of the Medial Side of the Knee and Their Surgical Implications

Matthew D. LaPrade,* Mitchell I. Kennedy,* Coen A. Wijdicks, PhD,* and Robert F. LaPrade, MD, PhD* †

• sMCL - Primary static stabilizer to valgus motion at all tested flexion angles (0, 20, 30, 60, and 90 degrees)
• Secondary external rotation stabilizer
• Secondary stabilizer for internal rotation

• dMCL – secondary restraint to valgus loads and restraint against external rotational torques at 30 degrees
• Maximum load 100 - 194 N with a mean displacement at failure to be 2.1 mm.

MCL Biomechanics

Anatomy and Biomechanics of the Posterior Cruciate Ligament, Medial and Lateral Sides of the Knee

Karl F. Bowman, Jr, MD* and Jon K. Sekiya, MD†

• Posterior stability of the knee in extension
• The contribution of the MCL to valgus stability is 78% with the knee at 25 degrees of flexion
• The ultimate strength of the MCL has been shown to be 665N when both layers were tested to failure
• Failure of the dMCL at 7 degrees of valgus opening of the knee and sMCL failure at 12 degrees of opening

Bowman et al. Sports Med Arthrosc Rev (2010);18:4
A complete understanding of medial knee biomechanics is necessary to assess which structures are to be given consideration when performing a repair or reconstruction.

If left untreated, it could potentially increase the risk for further injury.

In cases in which surgical repair or reconstruction is indicated, consideration should be given to repairing or reconstructing all injured medial knee structures.
MCL Biomechanics

The evaluation of the role of medial collateral ligament maintaining knee stability

- sMCL plays the most important role in limiting the valgus motion and the effect of dMCL is relatively smaller.
- MCL has a greater effect on limiting the internal rotation than the external rotation.
- The anterior part of the femur is more prone to injury in resisting valgus motion, and the posterior part in resisting external rotation.

MCL Image

- X-rays
- US
- MRI
- Thermography

MRI has been reported to be 87% accurate at detecting MCL injury.

Correlation of MRI findings with the clinical grade is difficult in grade 2 lesions.

MRI classification:
Grade 1 - subcutaneous edema adjacent to an intact MCL
Grade 2 - partial tears and high intrasubstance signal
Grade 3 - complete tears, characterized by complete ligamentous discontinuity with laxity or waviness

Feasibility study of simultaneous physical examination and dynamic MR imaging of medial collateral ligament knee injuries in a 1.5-T large-bore magnet

10 consecutive patients

Dynamic MRI and simultaneous physical joint examination

Average difference was 1.1 mm greater in the affected knee than in the intact contralateral side (90% grade 2)

Interobserver agreement was excellent (ICCs - 0.89 to 0.94)
MCL Image - Thermography

Infrared Thermal Imaging in Patients with Medial Collateral Ligament Injury of the Knee - A Retrospective Study

HyunJung Yang¹, HaeIn Park¹, Chungsan Lim¹, SangKyun Park², KwangHo Lee¹*

¹ Department of Acupuncture & Moxibustion Medicine, College of Korean Medicine, Sangji University, Wonju, Korea
² Department of Meridian, College of Korean Medicine, Sangji University, Wonju, Korea

- 20 patients
- Objectify the state of the disease by visualizing the temperature of the affected part
- Significant increase in temperature in affected compared to that of the unaffected knees
- Can be used as a supportive diagnosis instrument for a MCL injury

Yang et al. Journal of Pharmacopuncture 2014;17[4]:050-054
• US was able to predict the injury location and severity in 94% of patients
• Success in diagnosing acute or chronic medial knee laxity compared with a normal knee control group using applied stress combined with ultrasonography
• Limitations of this modality continue to be technical (limited experience in using ultrasound for diagnosing knee injuries)
AMA Classification:
Grade 1 - 0 to 5mm of medial opening
Grade 2 - 5 to 10mm of medial opening
Grade 3 - >10mm with a soft or absent endpoint

Fetto Classification (Functional - valgus stress at 0 and 30 degrees):
Grade 1 - 30 degrees - pain and minimal laxity (sMCL sprain)
Grade 2 - laxity at 30 degrees but stable at 0 degrees (sMCL torn, PMC intact)
Grade 3 - laxity at 30 and 0 degrees suggests complete injury to the sMCL and PMC

Tibiofemoral Joint Positioning for the Valgus Stress Test

Patricia A. Aronson, PhD, ATC*; Joe H. Gieck, EdD, PT, ATC†; Jay Hertel, PhD, ATC, FNATA, FACSM‡; Arie M. Rijke, PhD, MD‡; Christopher D. Ingersoll, PhD, ATC, FNATA, FACSM‡

• 12 patients
• Applied a valgus force (60 N) to the tibiofemoral joint in 0°, 5°, 10°, 15°, and 20° of flexion
• As the tibiofemoral joint is increasingly flexed, progressively fewer medial structures participate in resisting valgus stress
• Manual valgus stress test:
  Fully extend or flexion of 5° – all medial tibiofemoral joint structures
  15° to 20° of joint flexion - assess the MCL

Correlation of Valgus Stress Radiographs With Medial Knee Ligament Injuries: An In Vitro Biomechanical Study

Robert F. LaPrade, Andrew S. Bernhardson, Chad J. Griffith, Jeffrey A. Macalena and Coen A. Wijdicks

- Controlled laboratory study
- 18 adult lower extremities - Valgus stress radiographs
- Grade III MCL should be suspected with greater than 3.2 mm of medial compartment gapping compared to the contralateral knee at 20° of flexion
- Complete medial knee injury - gapping increases of 6.5 mm and 9.8 mm at 0 and 20°
Take Home Message

• MCL is not an important structure only in valgus motion restriction but also in knee rotational stability. Other ligaments are important in medial compartment stability as POL and dMCL

• MRI still the most popular exam. There are other tools that can help knee surgeons in the decision-making

• PE still the “gold standard”. Valgus stress X-rays – useful for the definitive diagnosis, management, and postoperative follow-up of patients
@drortopedista

Dr Gustavo Arliiani

@drgustavoarliiani

www.drgustavoarliiani.com.br