



ACL reconstruction and Meniscus Repair Rehab

For the Collegiate Athlete

Gary Johnson LAT, ATC, CSCS, SPT
UNC DPT 2015



Learning Objectives

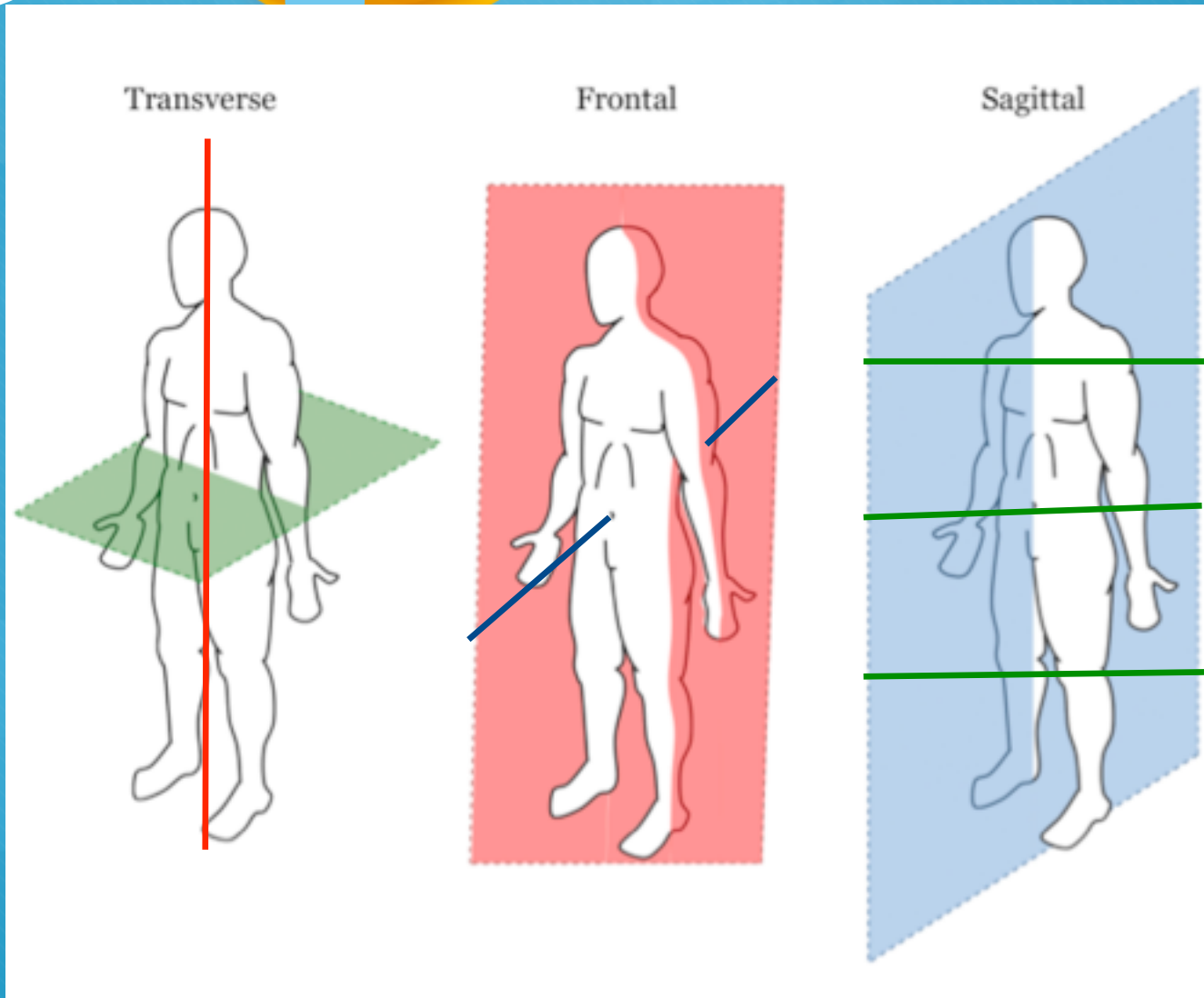
- Increased understanding of tissue healing properties in ACL reconstruction and meniscus repairs.
- Increased understanding of rehabilitation timeline of two common sports medicine injuries.
- Enhancement of intervention techniques when leading or assisting with an athlete rehabbing from a lower extremity post-surgical knee injury.
- Enhancement of therapeutic exercise “tool bag”.



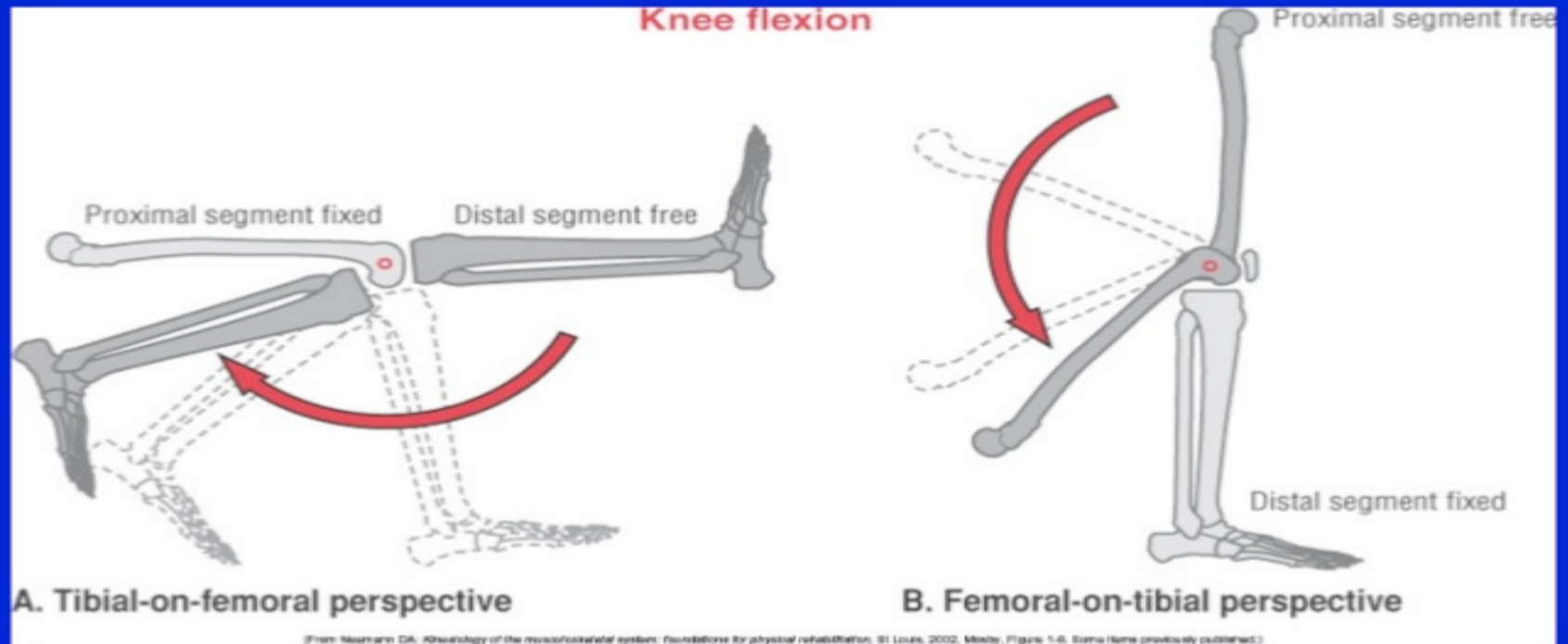
Sports Medicine

1. Management of the medical problems of exercising individuals at all ages and all levels of participation.
2. The pathophysiology, biomechanics and optimization of human performance.
3. The use of exercise as a therapeutic modality in the treatment and prevention of disease.
4. The promotion of health and the prevention of disease or injury at a population level.

Quick Review



Open vs. Closed Chain





ACL Injury

- Most commonly injured knee ligament.
- Approximately 100,000-200,000 ACL ruptures per year in the United States.
- Majority of injuries are non-contact injuries.
- According to the NCAA injury surveillance system, American football players have the highest ACL injury rate of all NCAA athletes (33%).
- ... but females have a greater predisposition to this type of injury*.



Meniscus Injury

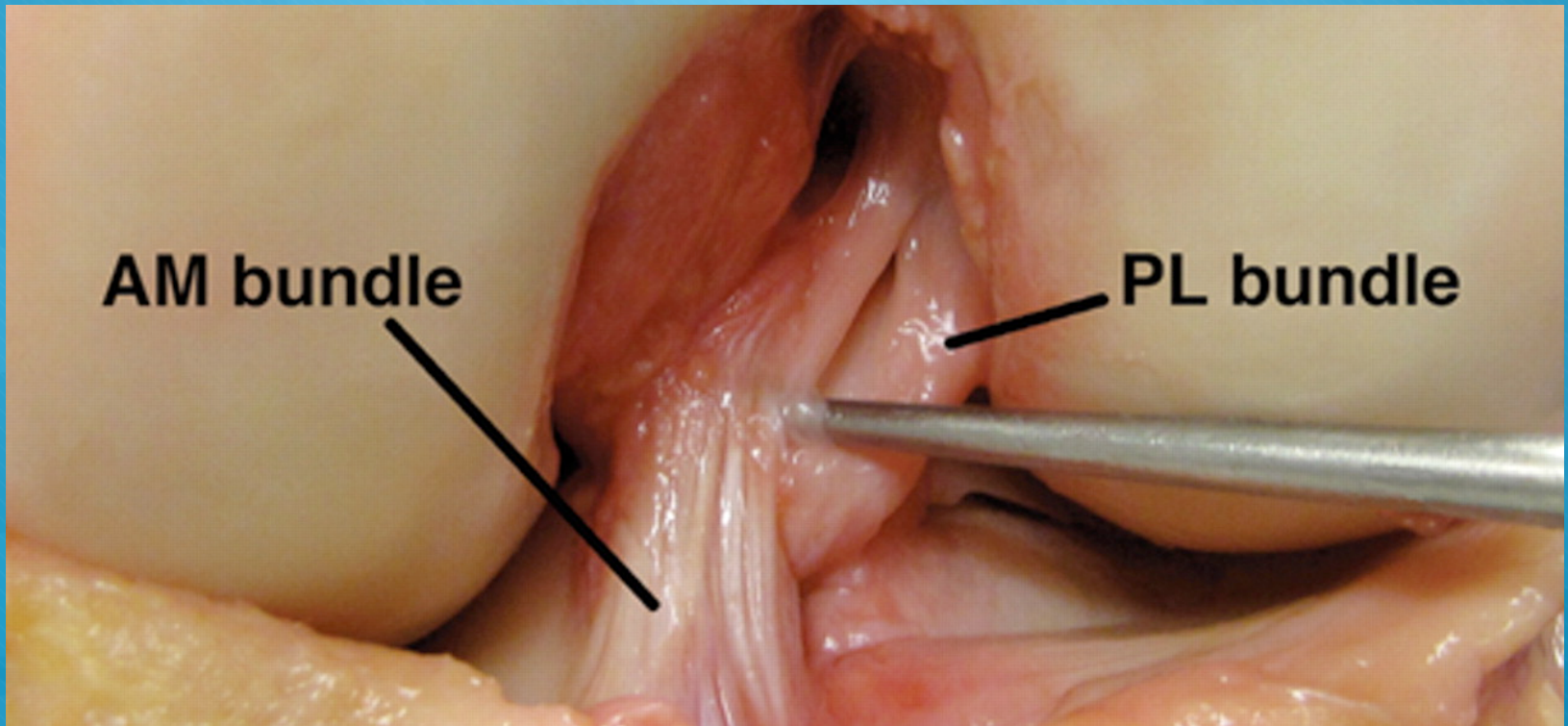
- Most common soft tissue injury in the knee.
- Account for 750,000 arthroscopies per year in the US.
- Acute tears often occur during dynamic twisting motions.
- Chronic degenerative tears are more common in older adults.



ACL Anatomy

- Primarily composed of collagen fibers (94%).
- Tibial attachment is wider and stronger than the femoral attachment.
- Contains mechanoreceptors that are sensitive to rapid movement.
- Double bundle ligament:
 - Anteromedial bundle: Primarily prevents anterior tibial displacement.
 - Posterolateral bundle: Dominant restraining force in knee extension.

ACL Ligament Anatomy





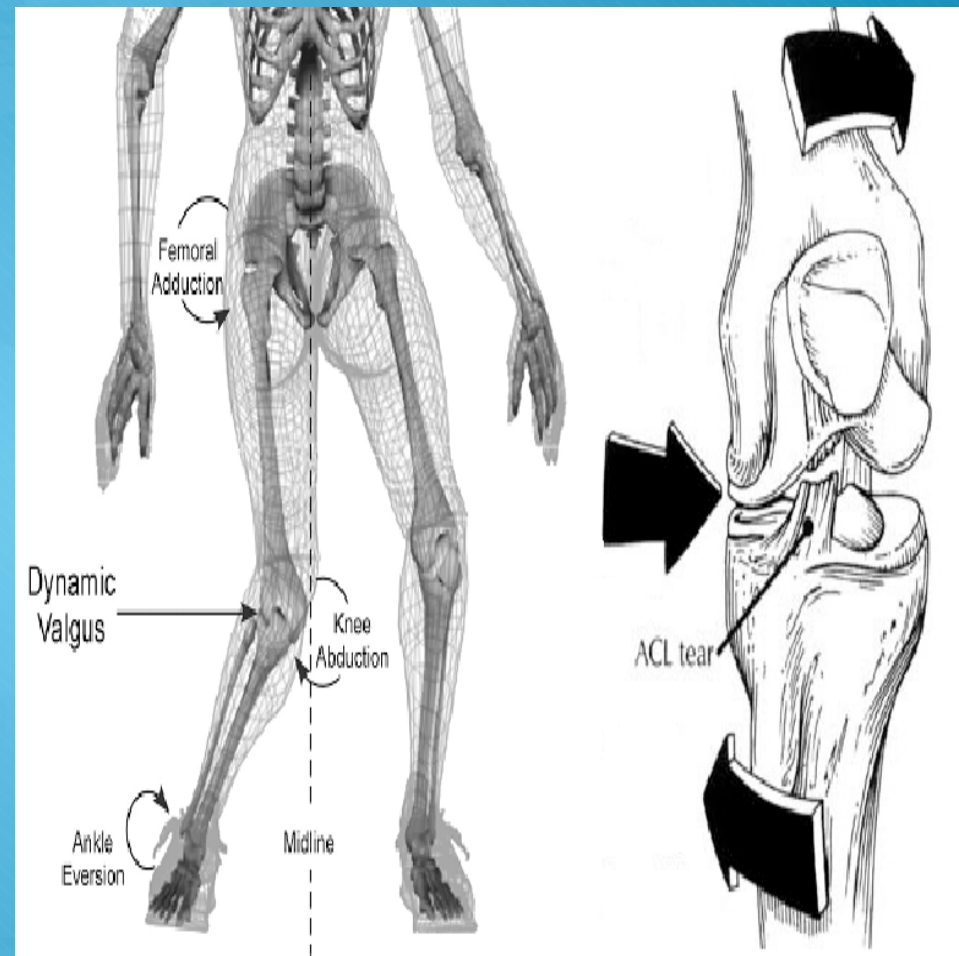
How is the ACL Injured?

- The ACL is the primary restraint of anterior translation of the tibia in relation to the femur (Prevents knee hyperextension)
- Valgus Injuries?
- GENU VALGUM: Latin - Definition
 - Genu→ Knee
 - Valgus→ bent outwards
- How does this knee position affect the ACL?

Dynamic Structures for Dynamic Movement

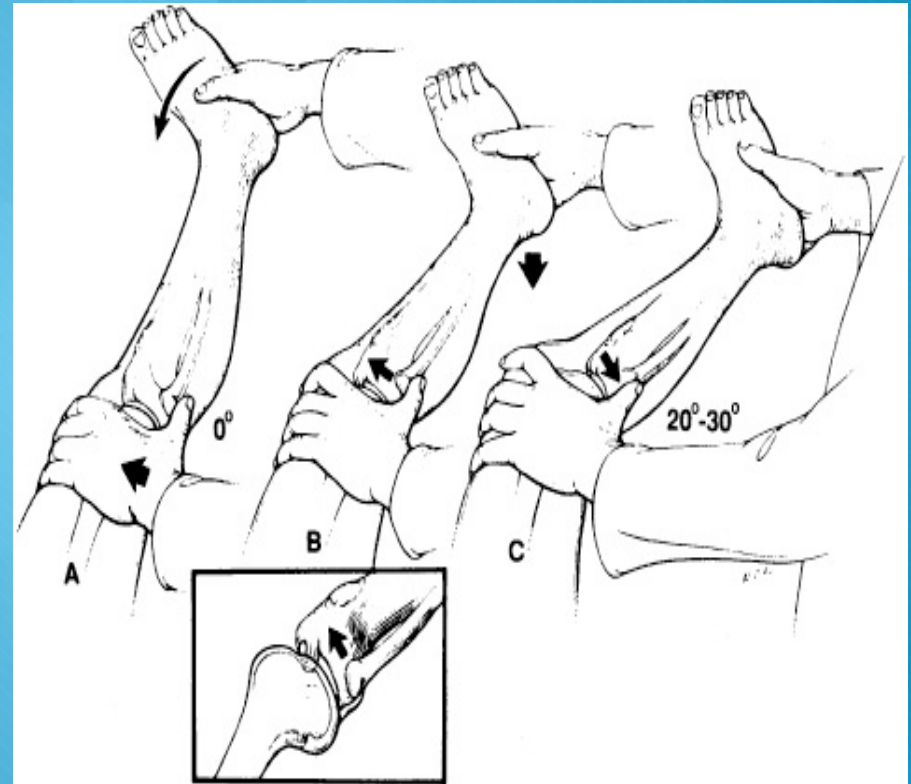
A 2009 Study by Quatman and Hewett.

- ACL injuries are multiplanar, don't just occur in sagittal plane. (Females)
- Load sharing amongst knee ligaments is intricate and complex.



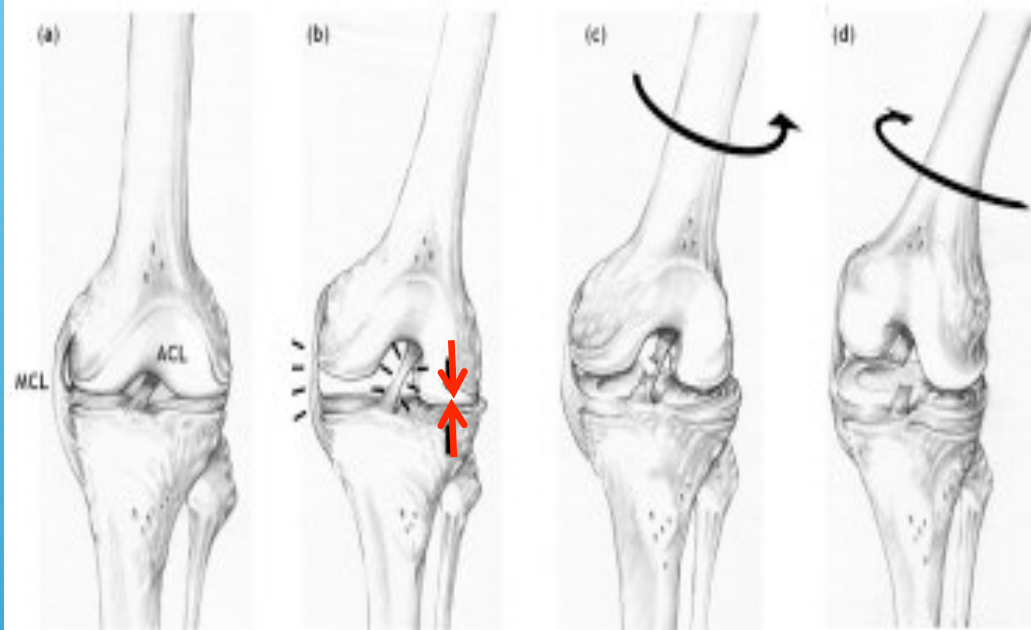
Quatman and Hewett cont.

- ACL and MCL offer restraint to external valgus moment.
- MCL may have higher rupture threshold than the ACL.
- Why perform lateral pivot shift test if the ACL is purely a sagittal plane restraint?



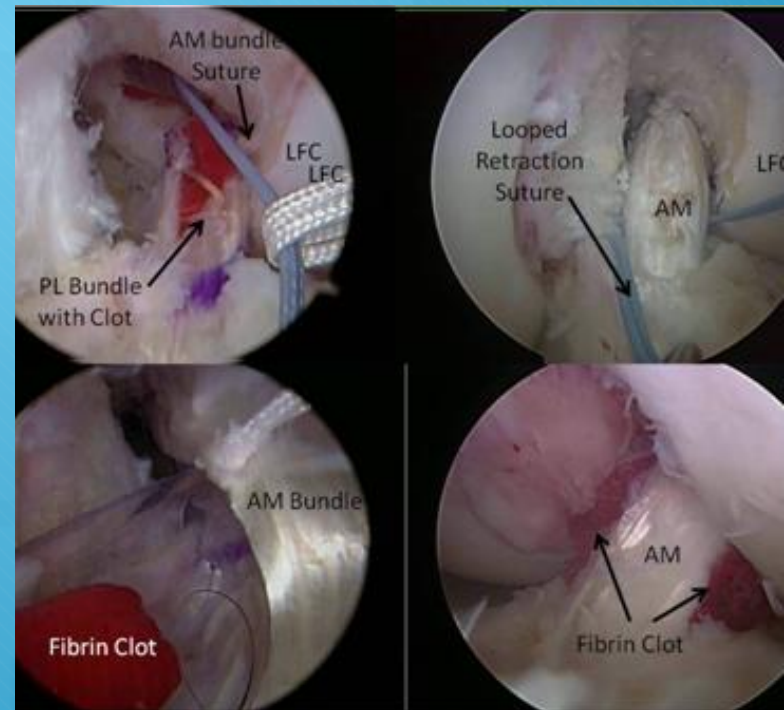
How is the ACL Injured?

- *Lateral cut, pivot* or landing from jump.
- Contact injuries.
- Clinical imaging of ACL injuries demonstrates valgus collapse.
- Static Valgus = ACL injury?
- ACL reflex decreases hyperextension, not valgus moment...



Why doesn't a sprained ACL heal?

- Scar tissue vs. normal tissue
- Inability to form “*Fibrin Clot*” in rupture.
- Surgical procedure using fibrin clot →



ACL Reconstruction Grafts

- Bone-patella-tendon-bone.
- Hamstring (Gracilis and semitendinosus)
- Allograft
- Xenograft





Menisci Anatomy

Medial Meniscus

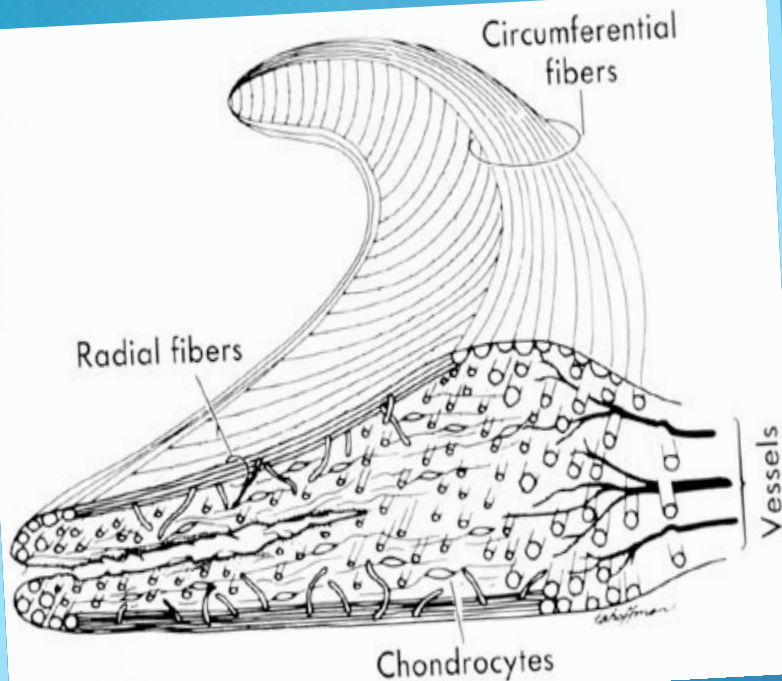
- ◊ C-shaped
- ◊ Attached to MCL and H/S
- ◊ Less mobile
- ◊ More commonly injured

Lateral Meniscus

- ◊ O-shaped
- ◊ More mobile

Menisci Anatomy

- Primarily Composed of Type I collagen fibers.
- Periphery is vascular, while the central portion is avascular (poor healing).
- Alignment of fibers is mostly “circumferential”, with decreased “radial” oriented fibers.





Longitudinal Tear
(short)



Longitudinal Tear
(long)



Longitudinal tear
(displaced bucket-handle)

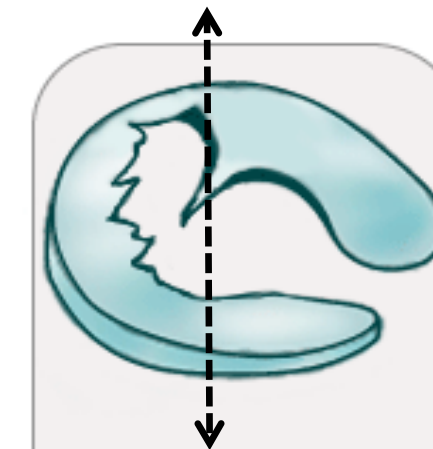
MendMeShop



Radial Tear
(small)

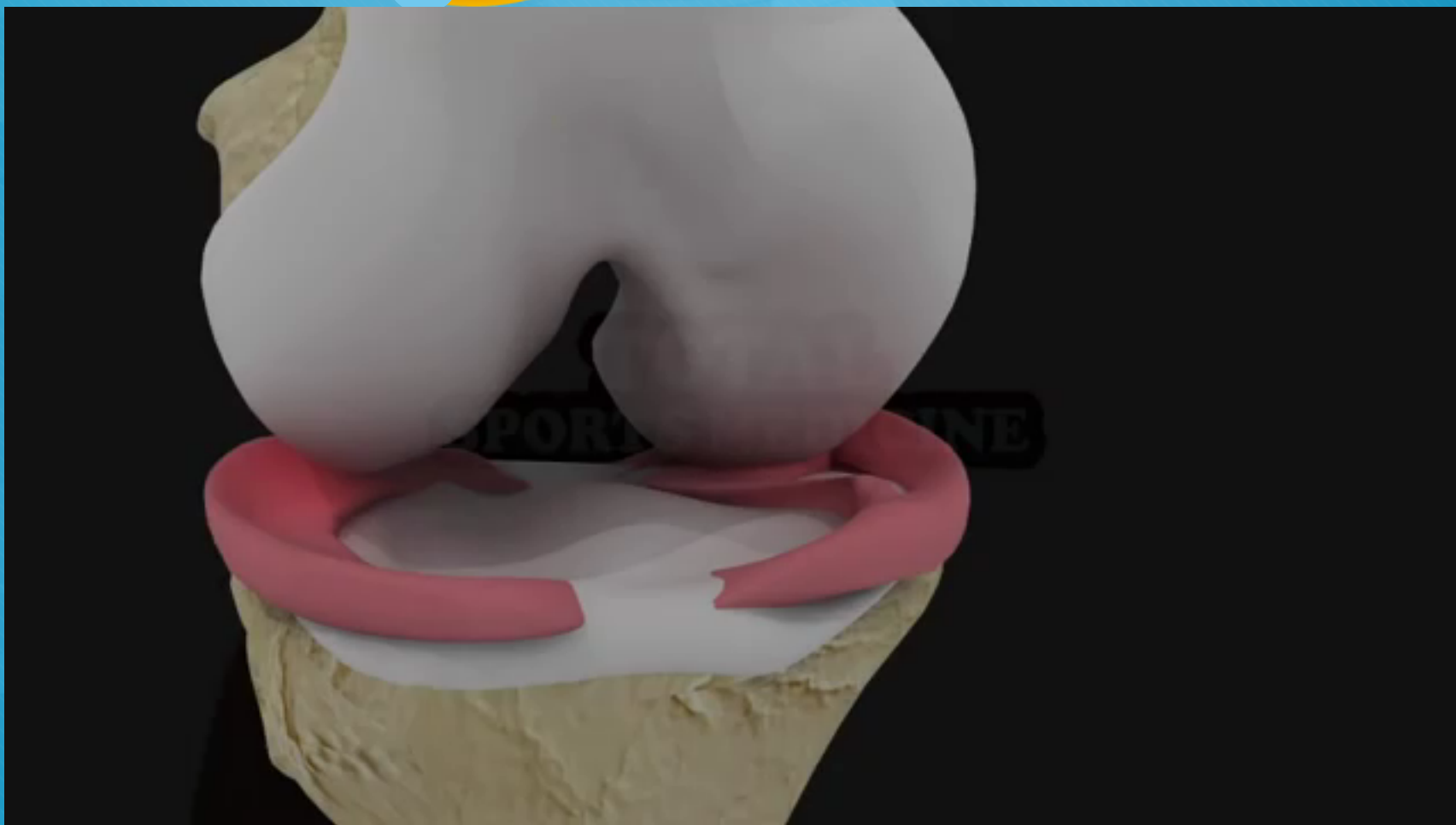


Radial Tear (large)



Progresses to a
Parrot's Beak Tear

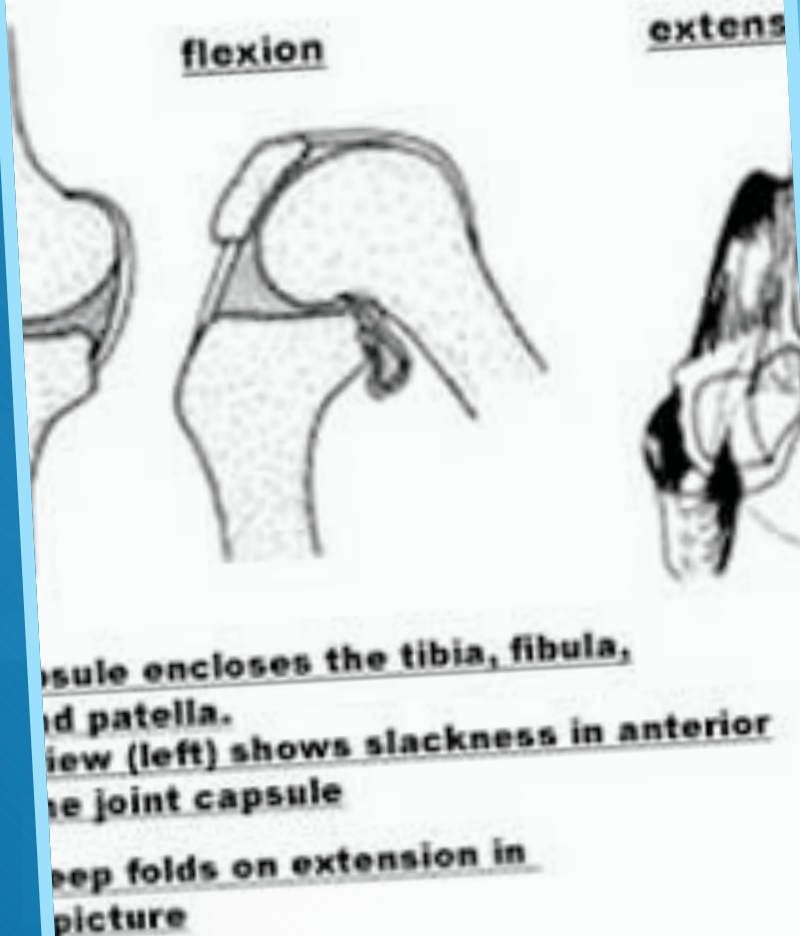
MendMeShop



Meniscus

Mechanism of Injury

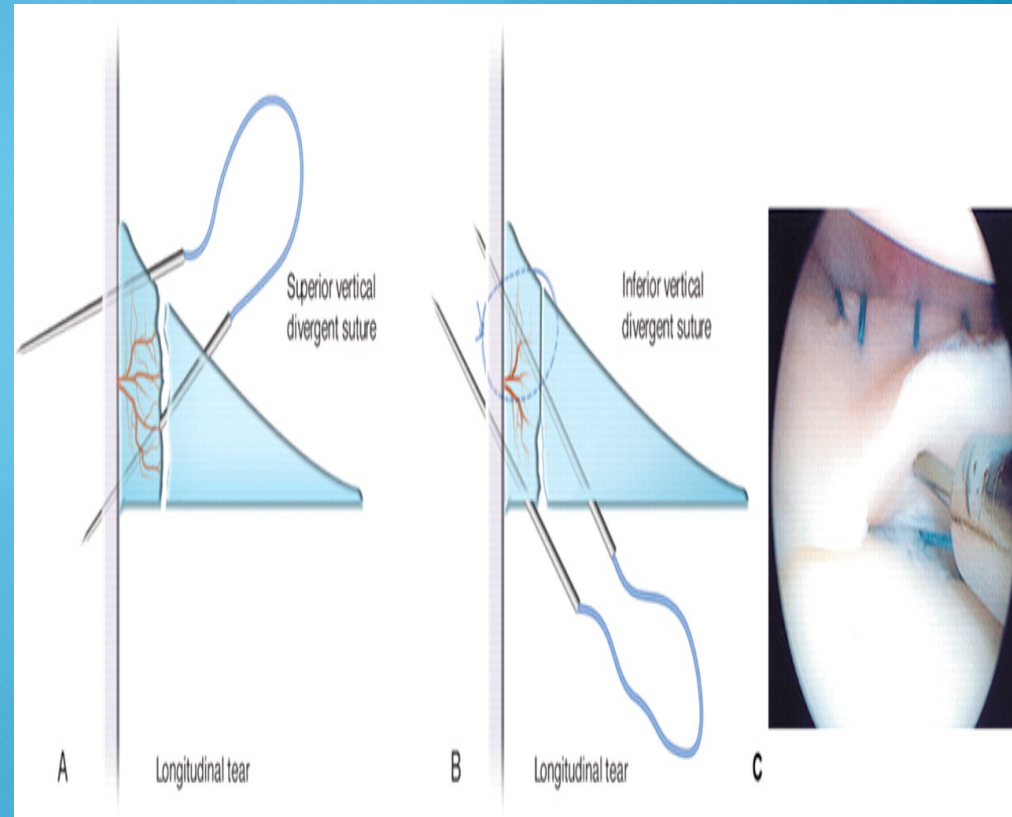
- Posterior horn of medial meniscus is most common sight of injury... why?
- Why is there a flexion ROM limitation with post-operative meniscus repairs?



Meniscus Repair Surgery

SEVERAL variations in surgical repair.

Strong evidence for double vertical suture repair in longitudinal meniscus tears.



Meniscus Repair





ACL and Meniscus Rehab

Outpatient Clinic

- Surgeon directed
- Physical therapist in charge of rehab
- 1-3 rehab sessions a week
- Extensive home exercise program
- Timeline is more flexible

Collegiate Setting

- Surgeon directed
- Physical therapist, athletic trainer, strength and conditioning coaches, dieticians, students etc.
- Multiple rehab sessions a day, 5-7 days a week
- Timeline = **pressure!**



The Collegiate Athlete and Rehab

- Diet
- Weight
- Psyche
- **REFER** when appropriate!!



Your responsibilities...

- Know your role
- Delegation
- Ask for help



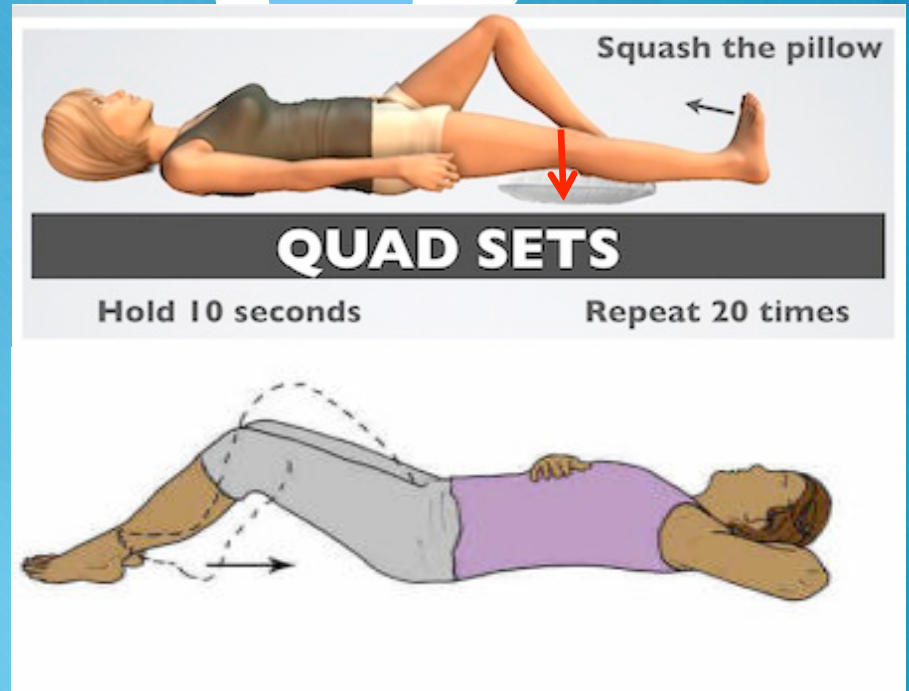
Pre-surgery Rehabilitation

- Goals

- Protect injured tissue and unstable joint
- Reduce edema and minimize pain
- Increase ROM and strength

Pre-surgery Rehabilitation

- R.I.C.E.
- Gait training
- Quad sets (QS)
- Flexion AROM and PROM
- **EDUCATE PATIENT**





Phase I ACL Reconstruction (ACL-R)

- ◊ 1 day to 4 weeks post surgery
- ◊ Goals
- ◊ Tissue



Phase I Meniscus Repair

- 1 day to 6-weeks post surgery
- Goals
- Tissue

Phase I Exercises

- Modalities for pain and swelling
- QS
- Heel slides
- Terminal knee extensions (TKE)
- Patellar mobilizations
- Gluteal strengthening
- Modalities for quad strength
- Gait Training

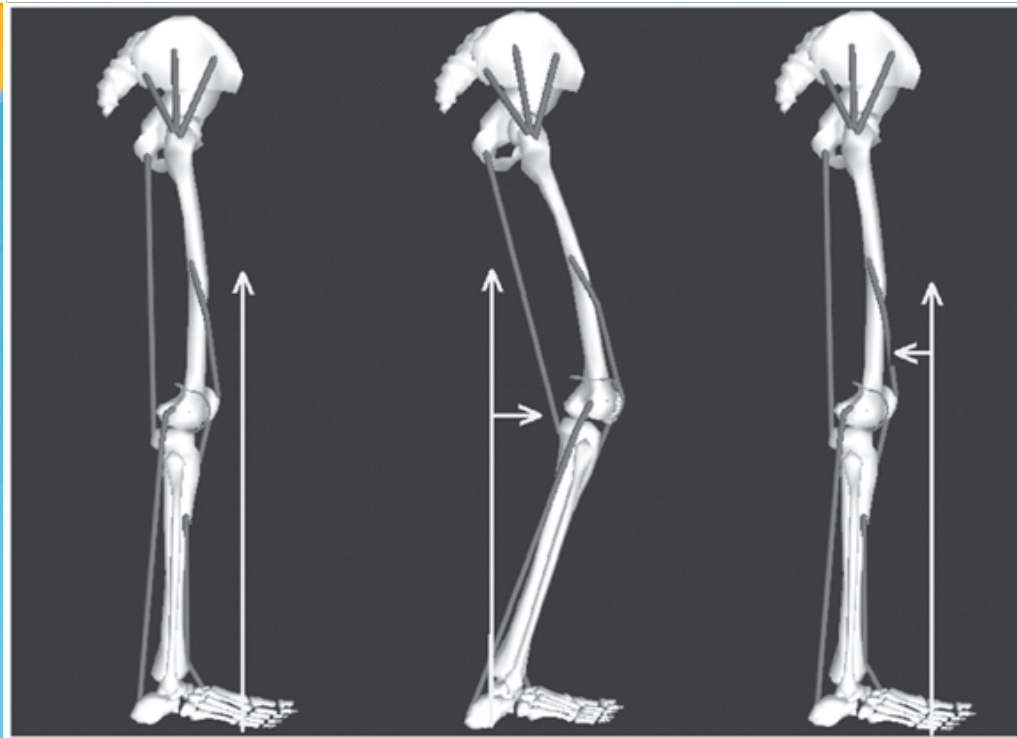


Figure 2 - The illustration of ground reaction force in normal gait, crouch gait and after the use of floor reaction



Patellar Mobilizations





Phase I Rehab

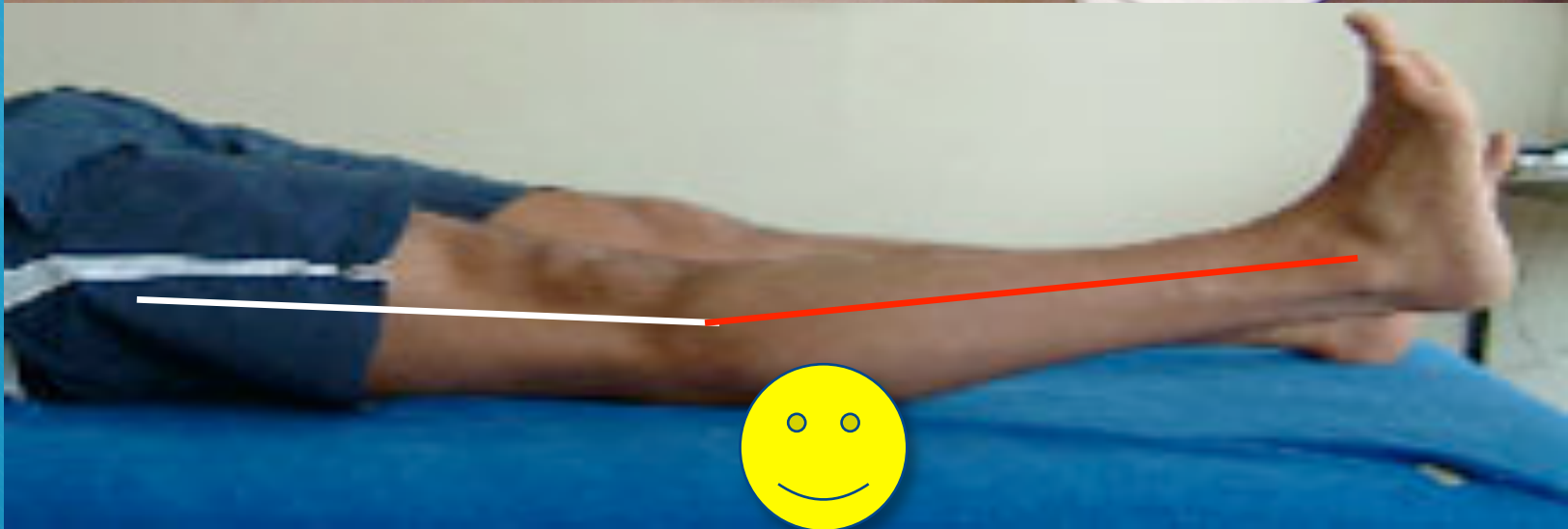
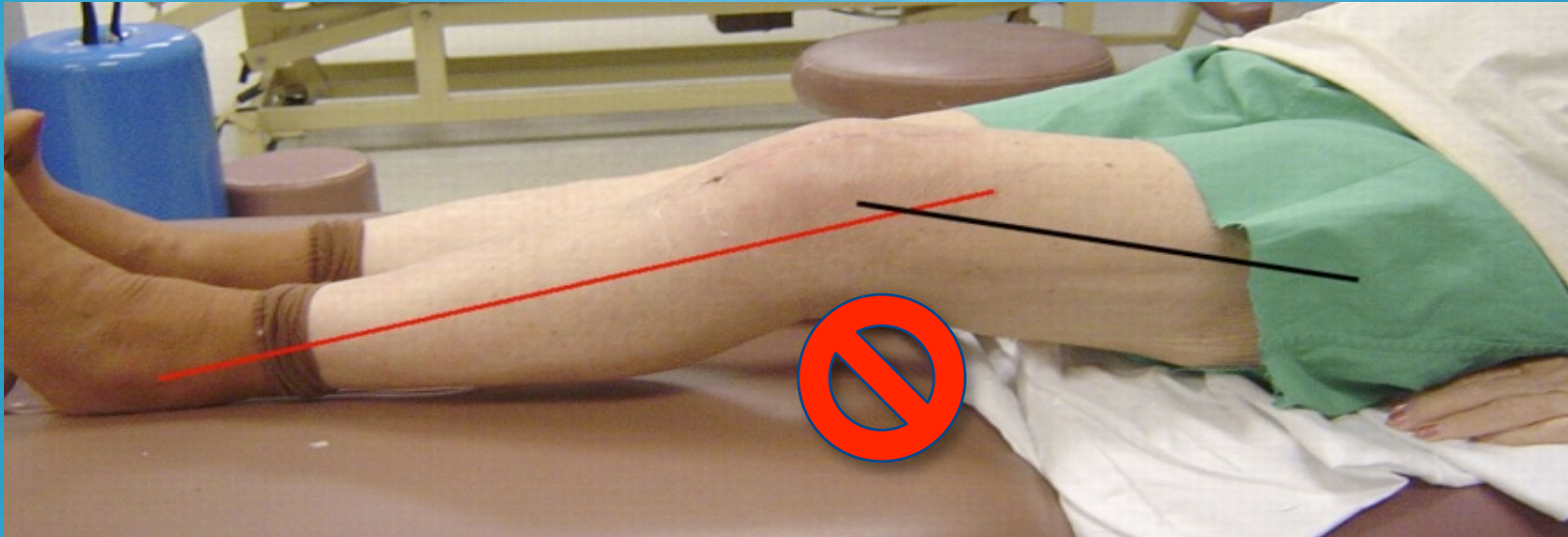
ACL-R

- Precautions
 - OKC vs. CKC
 - ROM precautions
 - WB status
 - Brace wear

Meniscus

- Precautions
 - Limit flexion to 90 degrees
 - WB status
 - Brace

Extension Lag





Phase II ACL-R

- ◊ 4-10 weeks post-surgery
- ◊ Goals
- ◊ Tissue
- ◊ Continue all interventions from phase I



Phase II Meniscus Repair

- 6 -12 weeks post surgery
- Goals
- Tissue
- Continue phase I interventions

Phase II Exercises

- Dynamic balance
- CKC activities
 - Squats
 - Calf raises
 - Leg Press
 - Eccentrics
- OKC activities (8-weeks)
 - Ball h/s curl
 - Leg extension machine





Phase II Rehab

ACL-R

- Precautions
 - Graft is at it's weakest
 - Athletes mindset
 - Physician orders

Meniscus Repair

- Precautions
 - Avoid deep knee flexion in CKC
 - Brace?



Phase III ACL-R

- ◊ 10-16 weeks post-surgery
- ◊ Goals
- ◊ Tissue
- ◊ Continue all interventions from phase II



Phase III Meniscus Repair

- ◊ 12-16 weeks post surgery
- ◊ Goals
- ◊ Tissue

Phase III Exercises

- Isokinetic Testing
- Running (Are they *ready* to run?)
- Light agility
- Begin Olympic lifts
- Cardiovascular training
- Strength training for power
- Strength coach assistance?





Phase III Rehab

ACL-R

- Precautions
 - Wait for surgeons clearance for impact activities
- Notes
 - Continue to challenge athlete
 - **SLIGHT** Soreness and swelling normal

Meniscus Repair

- Precautions
 - Surgeon clearance for:
 - CKC exercises with flexion $>60^{\circ}$
 - Sports specific drills



Phase **IV** ACL-R

- ◊ 16-24 weeks post surgery
- ◊ Goals
- ◊ Tissue



Phase **IV** Meniscus Repair

- 16-weeks post surgery to full RTP.
- ◊ Goal
- ◊ Tissue



Phase IV Exercises

- Aggressive agility
- Increased running distances and intensity
- Full return to Olympic lifts
- Functional tests
- Plyometrics

Plyometrics

Plyometric Phase	Volume (# of Jumps)
Early/ beginner	80-100
Intermediate	100-120
Advanced	120-140

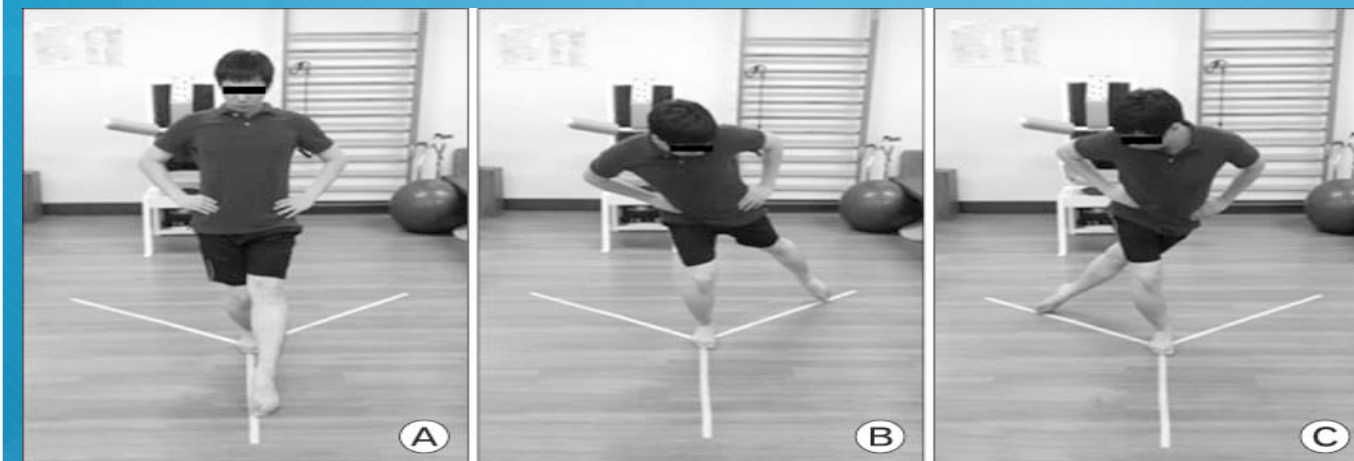
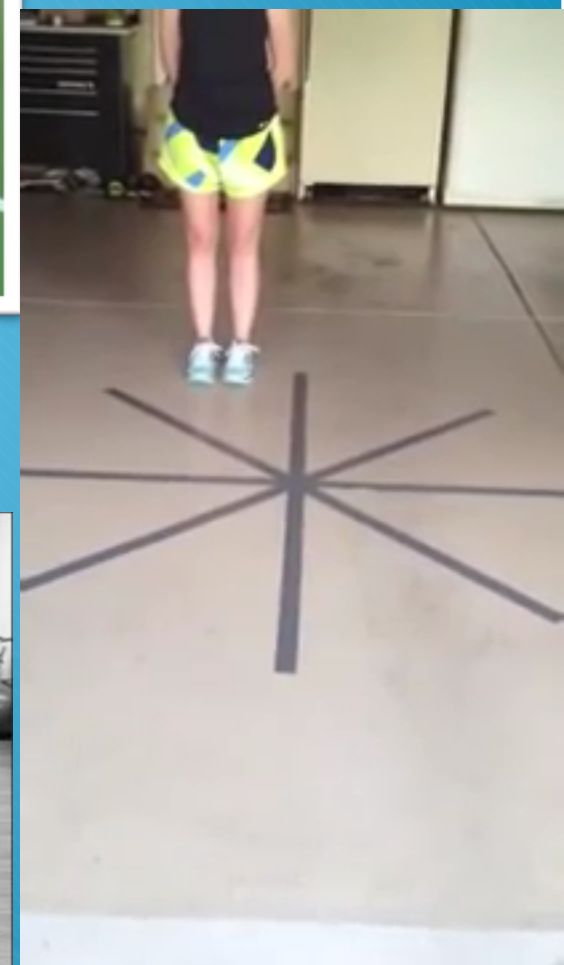
Lower Body Plyometric Exercises Considerations	
Strength	1 RM squat at 1.5% of athletes BW.
Speed	Able to perform 5 squat reps in 5 sec with 60% BW.
Balance	• Beginner: SLB x30sec hold • Intermediate: SL ¼ squat x30sec hold • Advanced: SL half squat x30sec hold
Weight	• ≥ 220 Lbs.: Avoid high intensity, high volume plyo training. • No depth jumps > 18in.

DEPTH JUMPS





Y-excursion Test





Phase IV Rehab

- ◊ Precautions

- ◊ Athlete *assumes* they are free to do EVERYTHING

- ◊ Notes

- ◊ Surgeon may prescribe brace for RTP



Phase **V** ACL-R

- ≥ 6 months post surgery
- Goals: Return to sport at **100%** participation
- Tissue
- Precautions

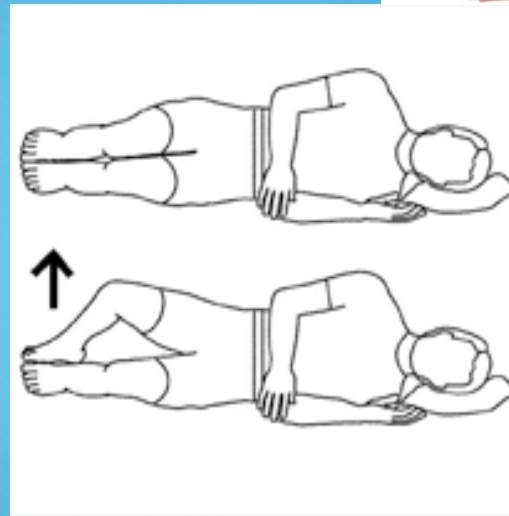
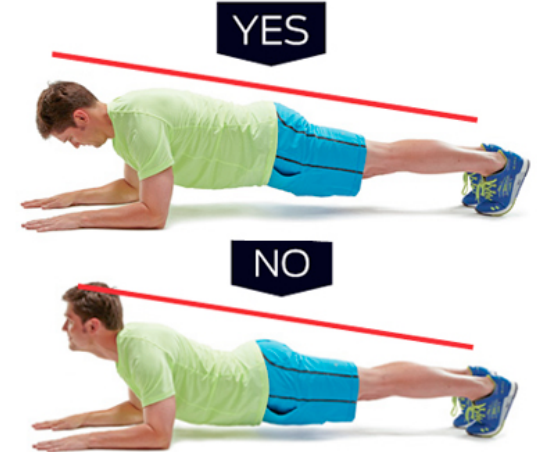
Final Rehab Phase Exercises

- Position specific drills
- Progression of contact drills in practice from light to full.
- Limited minutes in practice
- Include strength and position coaches.



Don't Forget

- Work the core
- Increase gluteal muscle strength to protect the knee joint (prevent valgus)
- Stretch
- Continue with modalities to decrease pain and swelling.
- Aerobic activities





Monitor...

- Complaints of locking, catching instability, pain.
- Loss of ROM.
- Slower than usual strength gains.
- Persistent joint effusion and inflammation.
- Talk with surgeon and other medical professionals as needed...



THANK YOU



References

- Duthon et al. Anatomy of the anterior cruciate ligament. *Knee Surg Sports Traumatol Arthrosc.* 2006; 14: 204-213.
- LaBella CR, Hennrikus W, Hewett TE. Anterior cruciate ligament injuries: diagnosis, treatment, prevention. *Pediatrics.* 2014; 133(5): 1437-1450.
- van Grinsven S, van Cingel REH, Holla CJM, van Loon CJM. Evidence-based rehabilitation following anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc.* 2010;18: 1128-1144.
- Chen CH. Graft healing in anterior cruciate ligament reconstruction. *Sports Medicine, Arthroscopy, Rehabilitation, Therapy & Technology.* 2009; 1: doi:10.1186/1758-2555-1-21.
- Fu FH, Bennett CH, Lattermann C, Ma CB. Current trends in anterior cruciate ligament reconstruction. Part 1: Biology and biomechanics of reconstruction. *American Journal of Sports Med.* 27(6): 821-830.
- Goldblatt JP, Fitzsimmons SE, Balk E, Richmond JC. Reconstruction of the anterior cruciate ligament: Meta-analysis of patellar tendon versus hamstring tendon autograft. *The Journal of Arthroscopic and Related Surgery.* 21(7): 791-803.
- Hauser RA, Dolan EE. Ligament injury healing: an overview of current clinical concepts. *Journal of Prolotherapy.* 3(4): 836-846.
- Janssen RP, Scheffler SU. Intra-articular remodeling of hamstring tendon grafts after anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc.* 2014; 22: 2102-2108.
- Brindle T, Nyland J, Johnson DL. The meniscus: review of basic principles with application to surgery and rehabilitation. *Journal of Athletic Training.* 2001; 36(2): 160-169.

References cont.

- **Kiapour AM, Murray MM. Basic science of the anterior cruciate ligament injury and repair. BJR. 3(2): 20-31.**
- **Krossgard MR, Dyhre-Poulsen P, Fischer-Ramussen T. Cruciate ligament Reflexes. Journal of Electromyography and Kinesiology. 2002; 12: 177-182.**
- **Smigielski R et al. Medial meniscus anatomy-from basic science to treatment. Knee Surg Sports Traumatol Arthrosc. 2015; 23: 8-14.**
- **Friedberg RP. ACL injuries. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA. Accessed: 02/22/2015. www.uptodate.com.**
- **Haklar U et al. Results of arthroscopic of partial or full thickness longitudinal medial meniscus tears by single or double vertical sutures using the inside-out technique. Am J Sports Med. 2013; 41(3): 596-602.**
- **Chivers MD, Howitt SD. Anatomy and physical examination of knee menisci: a narrative review of orthopedic literature. JCCA. 2009; 53(4): 319-333.**
- **Noyes FR, Heckmann TP, Barber-Westin SD. Meniscus repair and transplantation: a comprehensive update. JOSPT. 2012; 42(3): 274-290.**
- **Muller B, Bowman KF, Bedi A. ACL graft healing biologics. Clin Spors Med. 2013; 32: 93-109.**
- **Pinczewski LA et al. A 10-year comparison of anterior cruciate ligament reconstructions with hamstring tendon and patellar tendon autograft: a controlled, prospective trial. AJSM. 2007; 35(4): 564- 574.**

References cont.

- Quatman CE, Hewett TE. The anterior cruciate ligament injury controversy: is valgus collapse “a sex-specific” mechanism? Br J Sports Med. 2009; 43(5): 328-335.
- Schmidt T et al. Sterilization with electron beam irradiation influences biomechanical properties of and the early remodeling of tendon allografts for reconstruction of the ACL. Cell Tissue Bank. 2012; 13: 387-400.
- Kawamura S, Lotito K, Rodeo SA. Biomechanics and healing response of the meniscus. Operative Techniques in Sports Medicine. 2003; 11(2): 68-76.
- Lyons ME. Isokinetic hamstring: quadriceps strength ratio in males and females: implications of ACL injury .2006; 64: 1-14.
- Petersen W et al. The effect of locally applied vascular endothelial growth factor on meniscus healing: gross histological findings. Arch Orthop Trauma Surg. 2007; 127: 235-240.
- Hacke J. The Knee Joint: examination/intervention. [PowerPoint]. UNC Chapel Hill: UNC-DPT; 2013.
- Gross MT. Meniscal fibrocartilage: composition, structure, function, mechanical properties, and healing. [PowerPoint – Voicethread]. University of NC Chapel Hill DPT; 2014.
- Anderson BC. Meniscus injury of the knee. In UpToDate. Post TW (Ed), UpToDate, Waltham, MA. Accessed : 02/23/2015. www.uptodate.com.
- Baechle TR & Earle RE. Essentials of strength training and conditioning 3rd ed. Champaign, IL: Human Kinetics; 2008.



Questions/Comments?

garyejohns@med.unc.edu

gjohnson0823@gmail.com