SPORTS PHYSICAL THERAPY

PATHOPHYSIOLOGY OF LIGAMENT INJURIES

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PATHOPHYSIOLOGY OF LIGAMENT INJURIES

INTRODUCTION

- Ligaments of the skeletal system are dense connective tissues that attach bones across a joint.
- Ligaments play an important role in the neuro-muscular system by providing:
  - joints stability
  - sending sensory feedback to the central nervous system with information about stress, tension, joints' motion, stretch and pain (Riemann and Lephart 2002a).

PATHOPHYSIOLOGY OF LIGAMENT INJURIES

ANATOMY

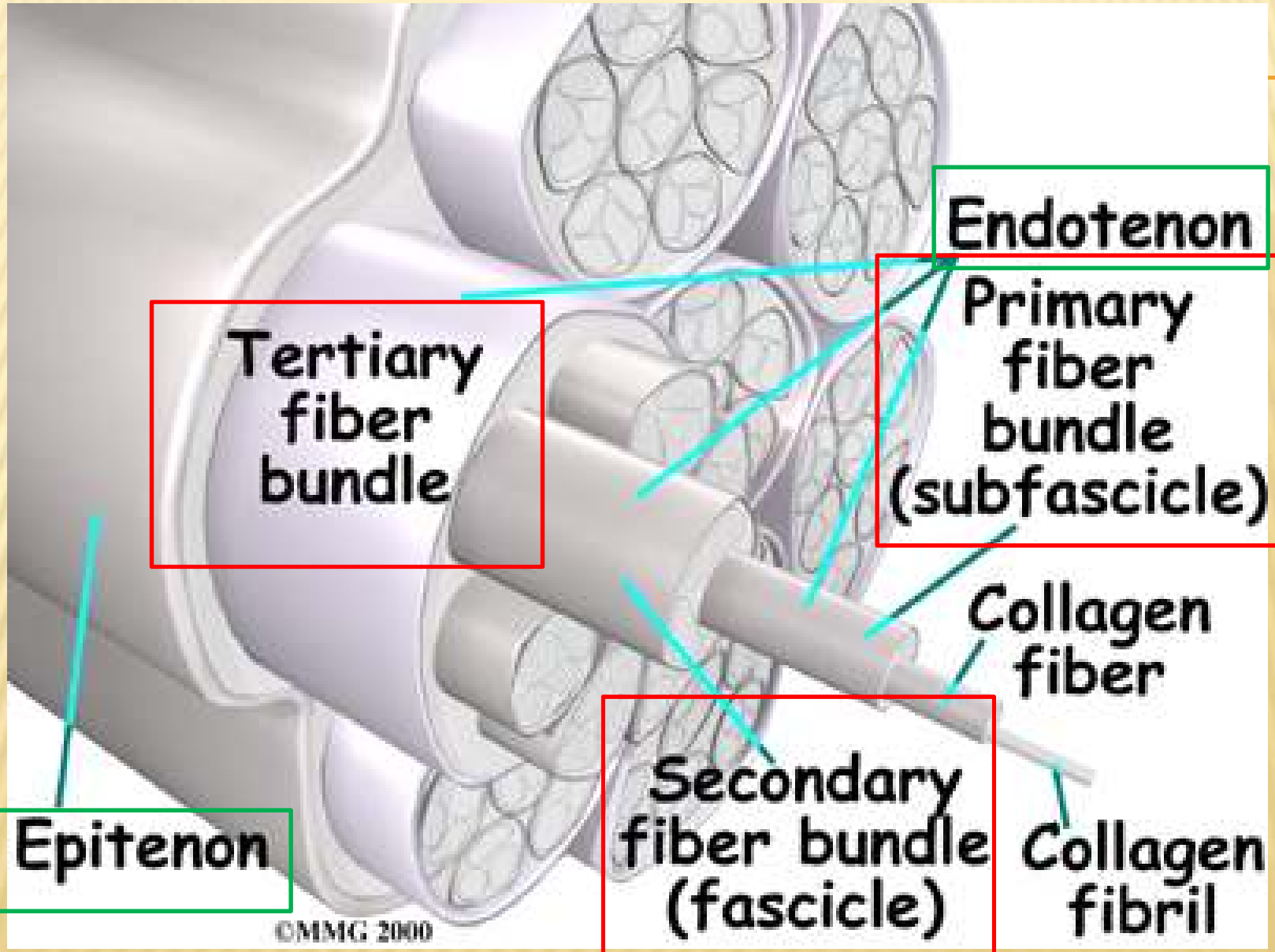
- Fibroblasts are the cells that exist in ligaments producing both the matrix and the collagen fibre.
- Fibroblasts are arranged in longitudinal rows parallel to the fibres and communicate with each other by a gap junction, a mechanism that is poorly understood (Chi et al. 2005).

PATHOPHYSIOLOGY OF LIGAMENT INJURIES

ANATOMY

- The matrix is composed of proteoglycans and collagen fibres (type I). In ligaments the most common proteoglycan is decorin, which strengthens the links between collagen fibres (Ilic et al. 2005).
- Composition
  - Collagen (60%) including ; type I (III, IV, V, VI, XII, XIV)
  - Proteoglycan (0.5%) including decorin, versican. In ligaments the most common proteoglycan is decorin, lumican
  - Glycoproteins (5%) including, tenascin, COMP, elastin

- After ligament gets injured during ligamentous healing process type III collagen level increases making it weakened structure comparatively.


Endotenon
Tertiary fiber bundle
Primary fiber bundle (subfascicle)
Collagen fiber
Epitenon
Secondary fiber bundle (fascicle)
Collagen fibril
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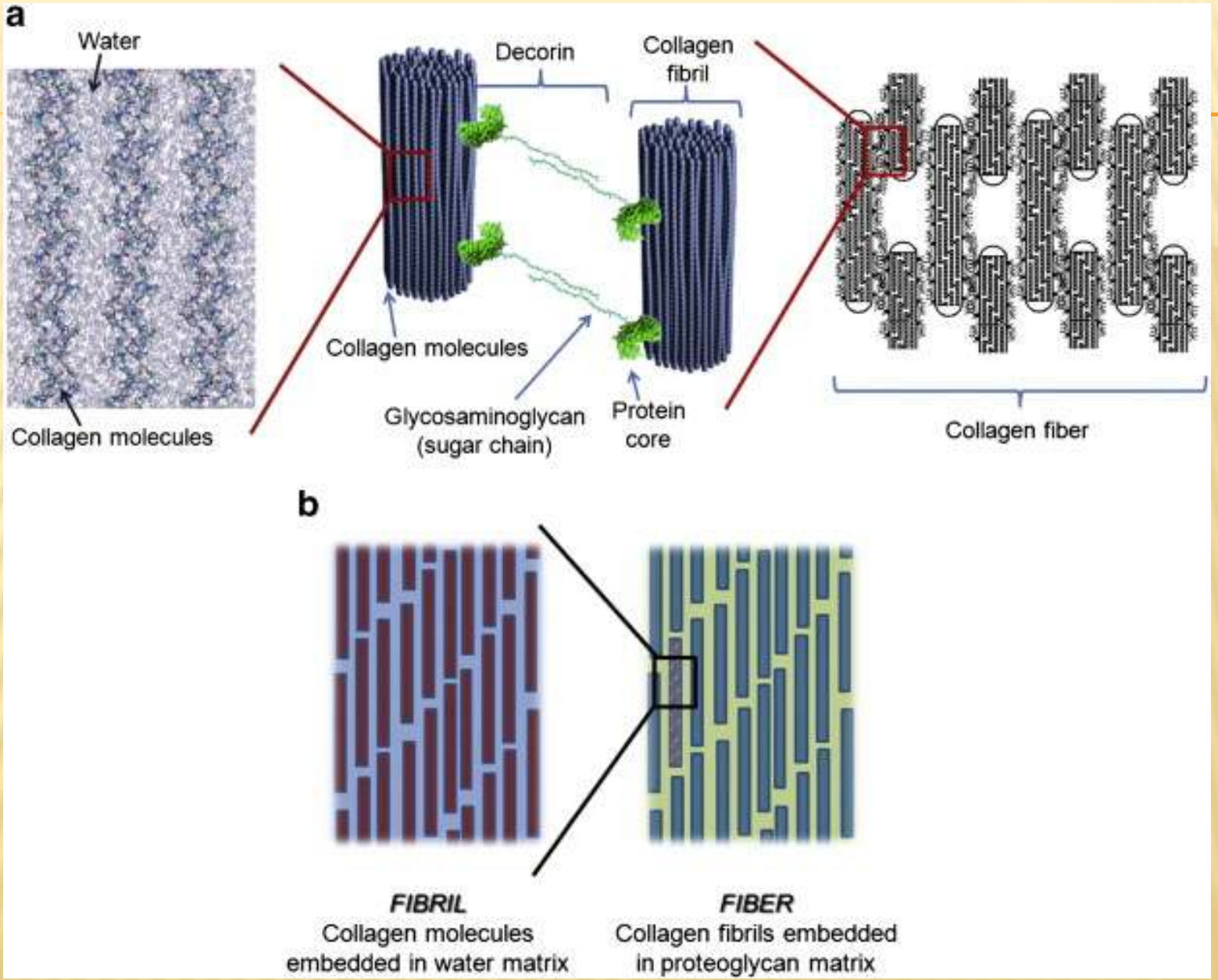
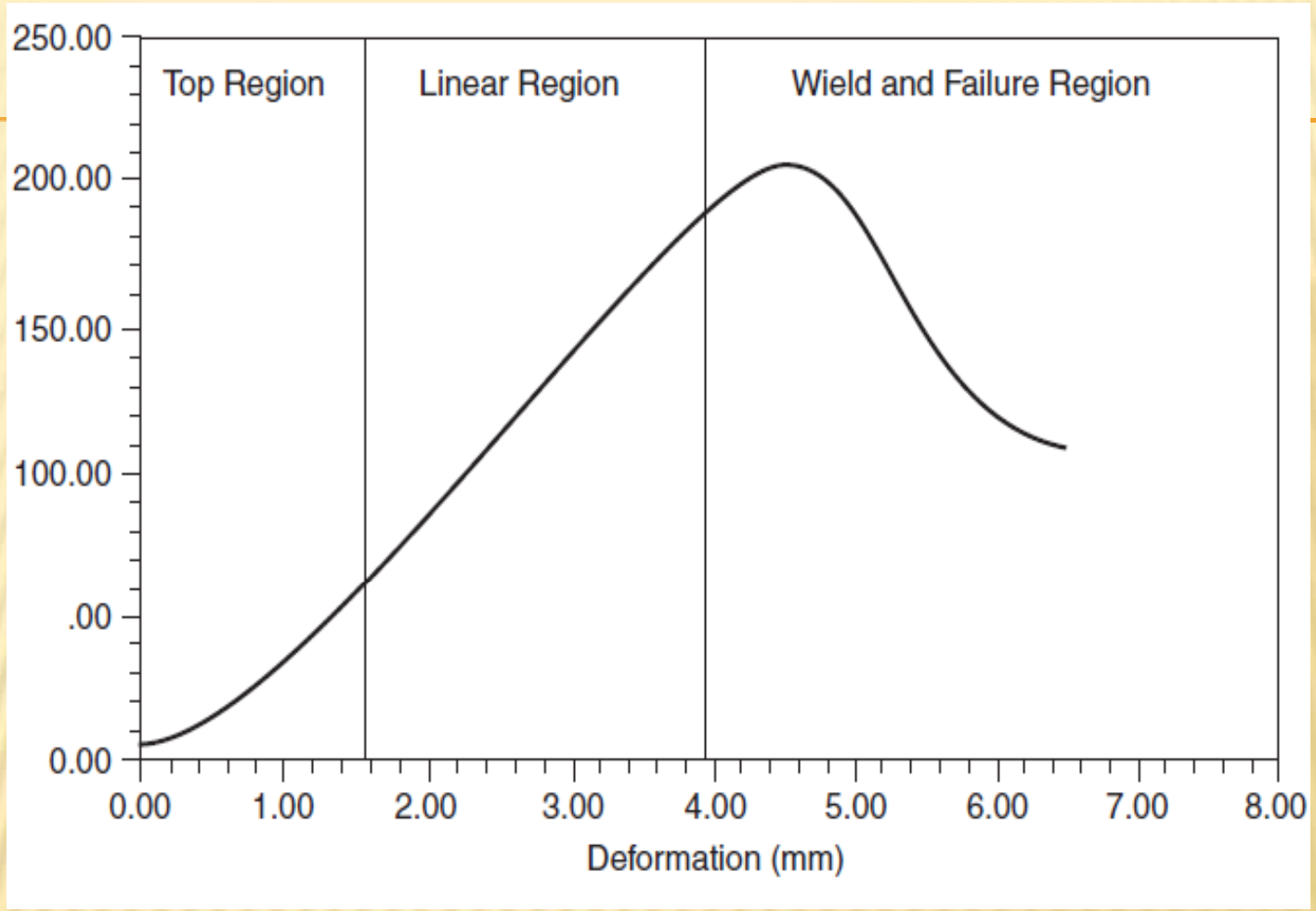

a
Water
Collagen molecules
Decorin
Collagen fibril
Collagen molecules
Glycosaminoglycan (sugar chain)
Protein core
Collagen fiber
b
FIBRIL
Collagen molecules embedded in water matrix
FIBER
Collagen fibrils embedded in proteoglycan matrix

BLOOD SUPPLY

- ligaments are hypovascular and their blood supply is better closer to the bones' atachments; the middle section is poorly supplied (Bray et al. 1996).

NERVE SUPPLY

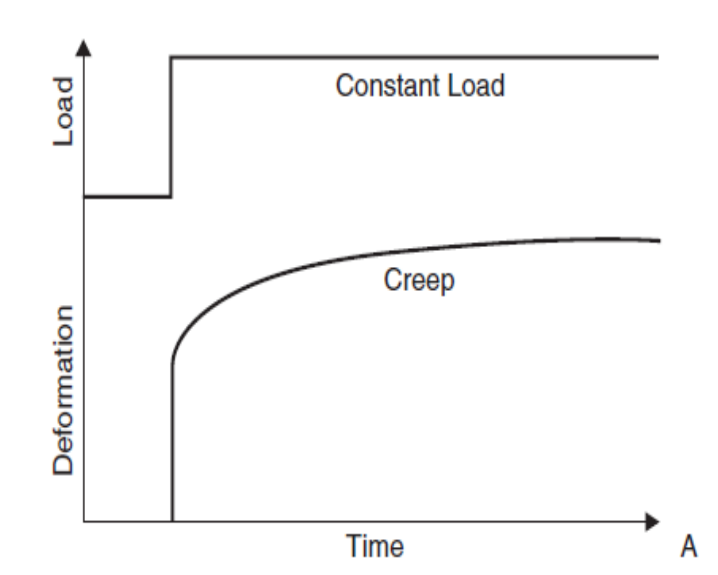
- Ligaments carry two types of sensory impulses to the central nervous system: mechanoreceptor and pain
- Remodeling after injury ➔habitual reduction in usage of area ➔ lack of stability
- Corrupted sensory input to CNS➔ corrupted muscular contraction pattern.



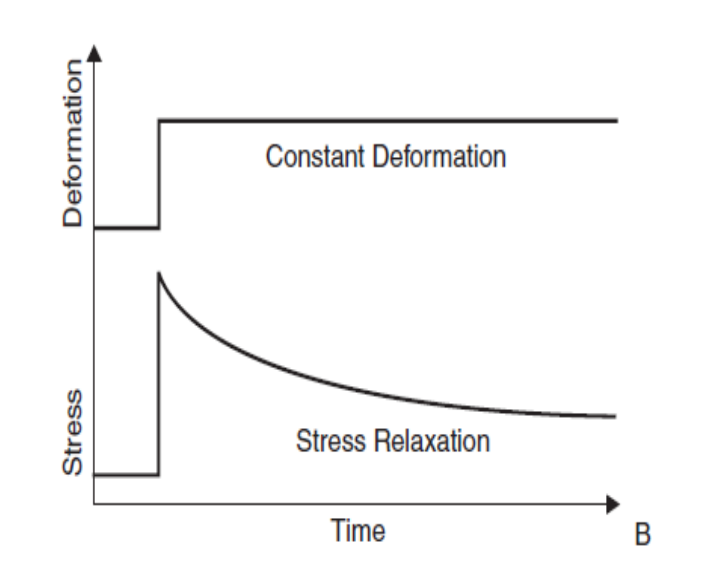
Stress-Strain graph.

VISCOELASTIC BEHAVIOR

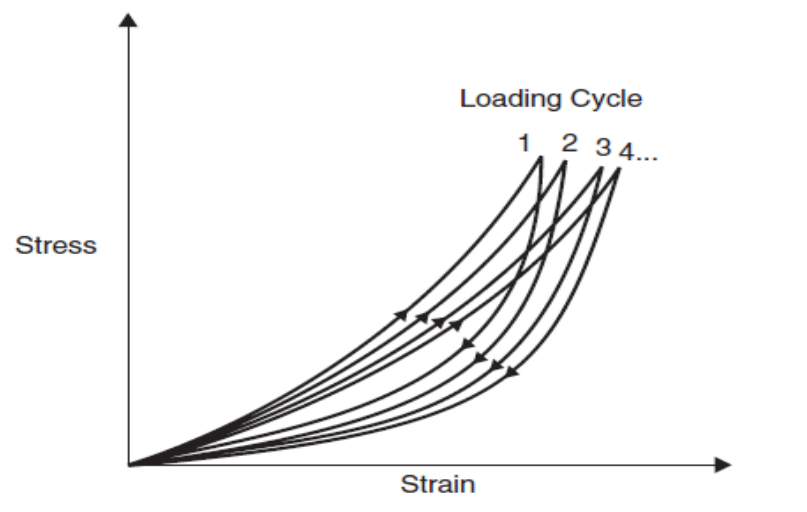
- Creep= constant load➔ progressive strain till equilibrium phase
- Stress relaxation= Constant Deformation➔ progressive decrease in load till equilibrium phase
- Hysteresis= inability to come to original length immediately➔ energy lost in the process➔ increased strain to the same stress



Ligament creep.



Stress relaxation relationship in ligaments.



Hysteresis.

NORMAL CHANGES IN RELATION TO LIFE

- No gender difference → pre puberty
- After puberty→ more ligamentous laxity in females
- Risk of injury → 3 folds higher in adolescent females
- Hormonal effect

PATHOLOGY

- Pathological changes in ligaments may occur due to structural and functional failure
- agreed degrees of ligaments strain:
  - 1st degree is mild
  - 2nd degree moderate
  - 3rd degree is a complete tear

IMPAIRED HEALING PROCESS

- Formation of scar tissue during healing phase:
  - Smaller collagen
  - Weakened cross linkages
  - Reduced creep
  - Uneven matrix
- Scar tissue formed by type III collagen

PARAMETERS OF LIGAMENTOUS HEALING

- The healing process depends on few parameters:
  - An isolated strain heals better than when it combines with other tissue's injury
  - The degree of the injury;
  - Certain ligaments heal better than others (such as the MCL compared with the ACL)
- Failure of the repair process can appear months post injury
- The viewpoints of the main two treatments are the immobility, long rest and braces versus the sooner-than-later active treatment

LATERAL ANKLE SPRAIN

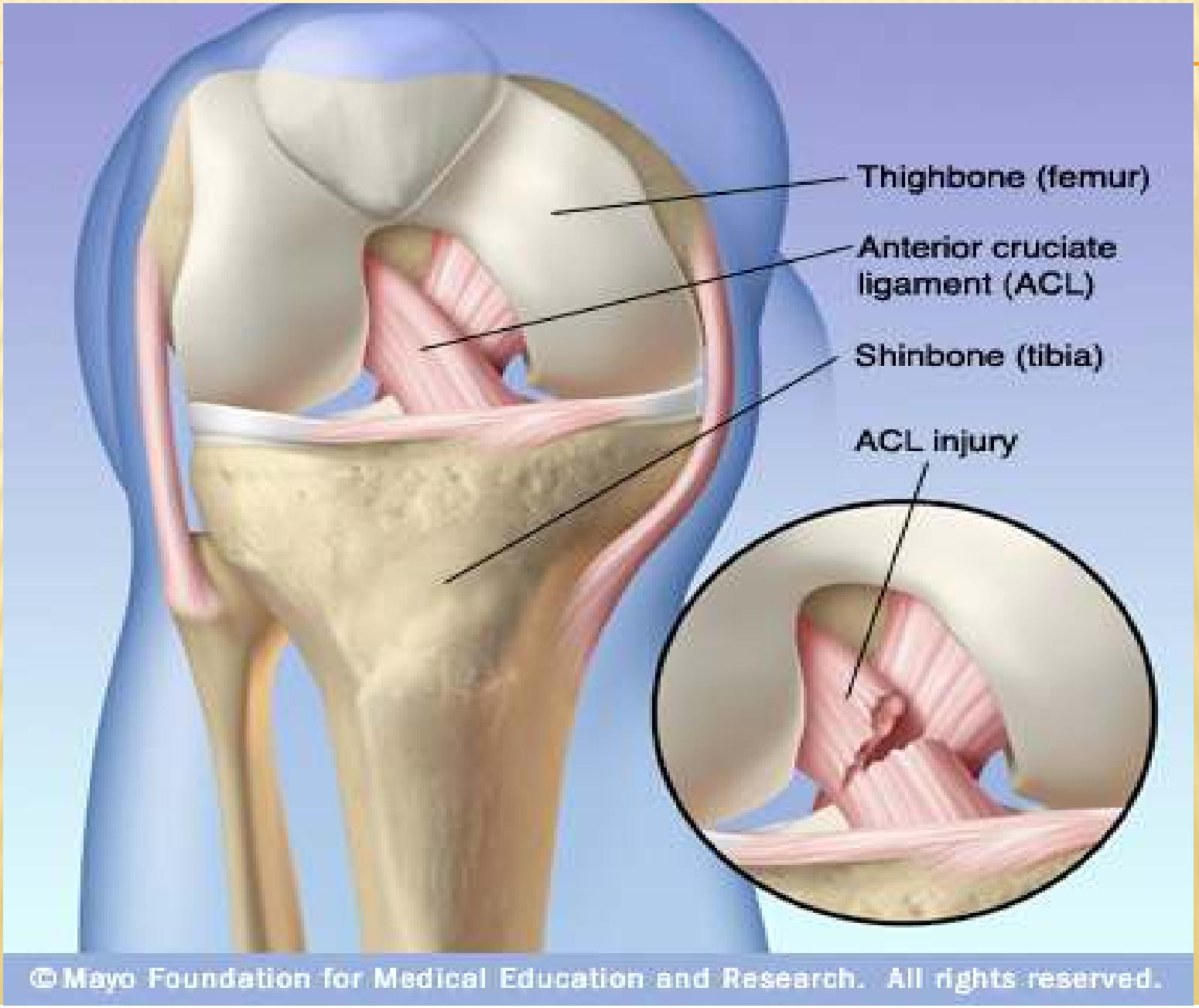
- The ankle joint is one of the most common sites of ligament injury with a higher reoccurrence rate compared to other ligament strains
- The most common ligamentous injury is to the lateral ankle, and to the anterior talofibular ligament in particular.
- Lateral ankle injury happens mostly by an excessive supination due to mechanical and/or functional instability

- The most common treatment for grade I and II during an acute sprained ankle is RICE
- Early exercise, which includes dorsiflexion and plantarflexion range-of-motion exercises, and isometric and isotonic strength-training exercises are recommended by many authors .
- Another treatment is balance and coordination training performed on the wobble board, both as a treatment and preventative measurements

PHYSICAL THERAPY MANAGEMENT

ACL INJURIES

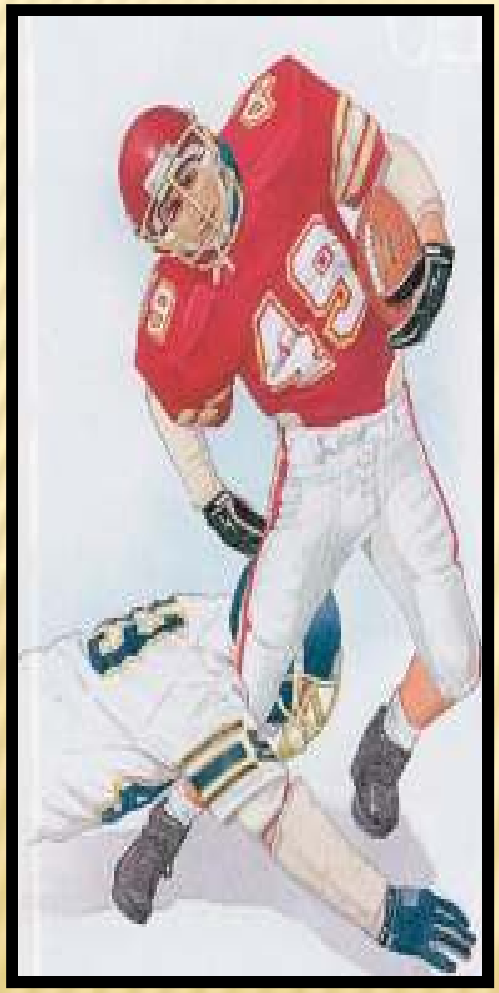
WHAT IS THE ANTERIOR CRUCIATE LIGAMENT (ACL) ?

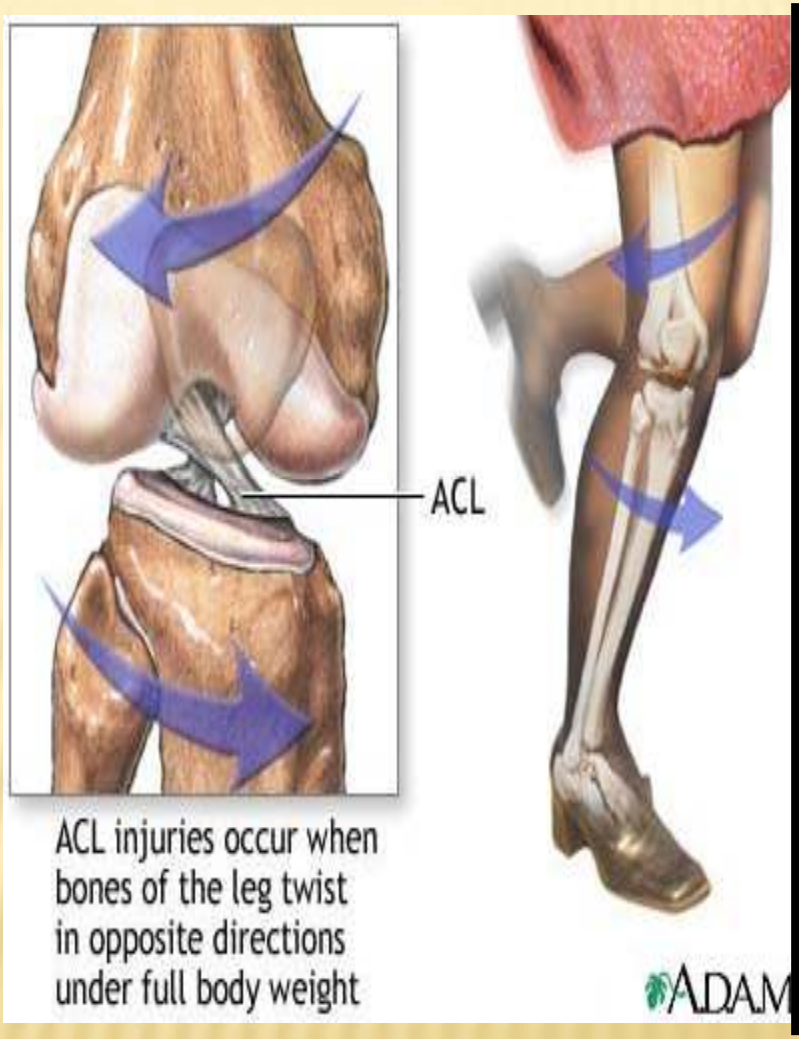


THE MAJOR RISK FACTORS ASSOCIATED WITH ACL

1. MALALIGNMENTS,
2. LIGAMENTOUS LAXITY,
3. LOWER EXTREMITY MUSCULAR STRENGTH
4. NEUROMUSCULAR CONTROL,
5. HORMONAL INFLUENCES,
6. INTERCONDYLAR NOTCH WIDTH
7. THE BIOMECHANICS OF THE ATHLETES' SPORTING TECHNIQUES

MECHANISM OF INJURY





TYPES OF ACL LIGAMENT SPRAIN

- Type I ACL sprain: the ligament is stretched but not torn
- Type II ACL sprain: there is mild looseness or laxity at the knee with partial tear of the ligament
- Type III ACL sprain: the joint is very loose and unstable because the ligament is completely torn.

SIGNS AND SYMPTOMS OF ACL TEAR

- Acute
  - Marked pain
  - Significant knee swelling
  - Difficulty bearing weight
- Chronic
  - The knee feels loose
  - Feeling of “buckling”, “giving way” or instability
  - Pain and swelling

DIAGNOSIS

- History
- Physical exam
- X-rays→ usually normal but should be obtained to ensure that there is no fracture
- MRI-excellent for evaluating not only the ACL but also the meniscus, articular cartilage and other knee ligaments

ACUTE TREATMENT FOR AN ACL TEAR?

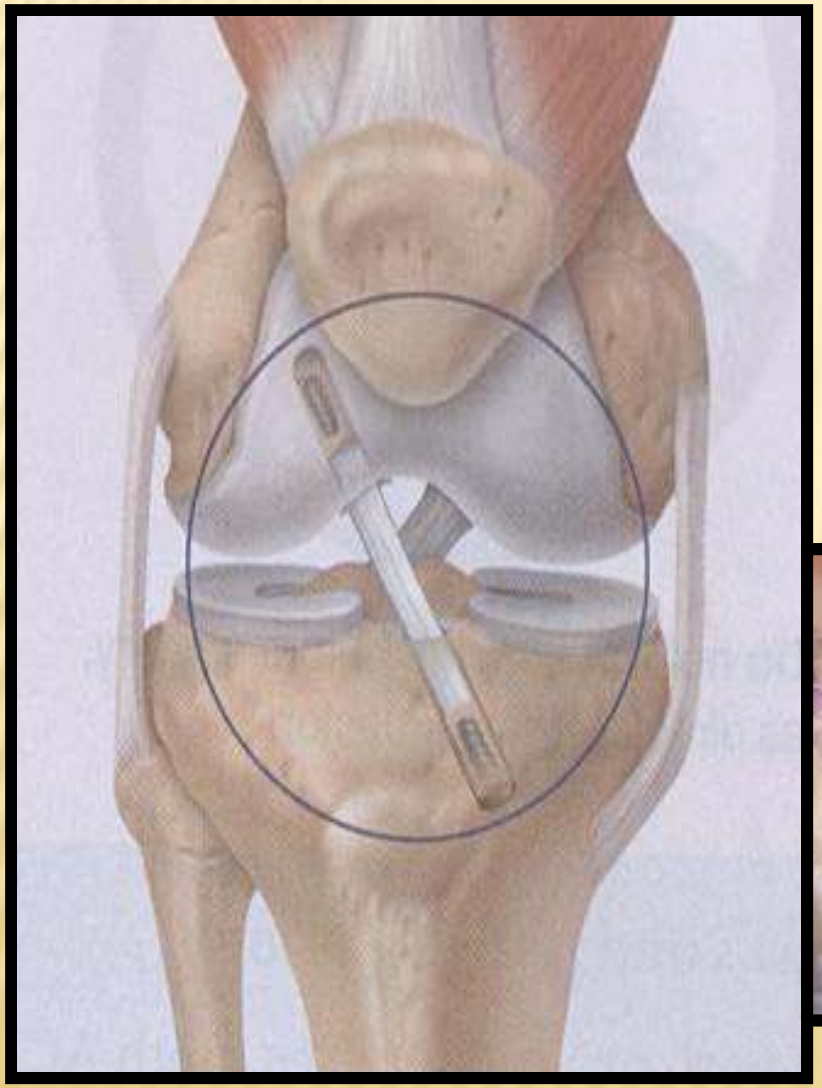
- Rest
- Ice
- Elevation
- Compression
- Protected Weight Bearing
- Brace

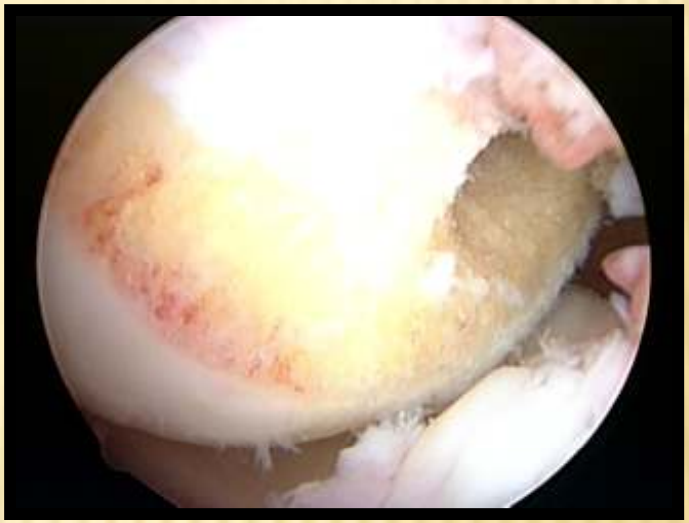
Middle third of patellar tendon cut and removed

GRAFT CHOICES

- Auto graft (your own tissue)
  - Bone-Patellar Tendon-Bone
  - Hamstring auto graft
- Allograft (cadaver)

SURGERY





DOES EVERYONE WITH A TORN ACL NEED SURGERY?

- No!
- Who does not need surgery?
  - Patients with very advanced arthritis
  - Patients who do not do activities that require an intact ACL?
  - Patients who are not interested in committing to post-operative rehab

REHABILITATION

- A rehab program should include:

1. Flexibility exercises.
2. Strengthening exercises.
3. Endurance activities.
4. Coordination and agility training (for competitive athletes).

REHABILITATION

Electrotherapy Modalities include:

- Ultrasound
- Laser
- Transcutaneous Electrical Nerve Stimulation (TENS)
- Magnetic Field Therapy

Local Modalities include:

- Ice
- Heat

REHABILITATION

Five phases

- Phase I- Immediate post-op (0-2 weeks)
- Phase II- Early Rehabilitation Activities (2-6 weeks)
- Phase III- Advanced Rehabilitation Activities (6-10 weeks)
- Phase IV- Advanced Functional Activities (10 weeks-6 months)
- Phase V- Return to Sport (6-12 months)

REHABILITATION

WEEKS 0-2:

- Non weight bearing
- Quadriceps and Hamstring isometrics
- Electrical muscle stimulation
- Ankle ROM and strengthening
- Heel slides
- Patellar mobilization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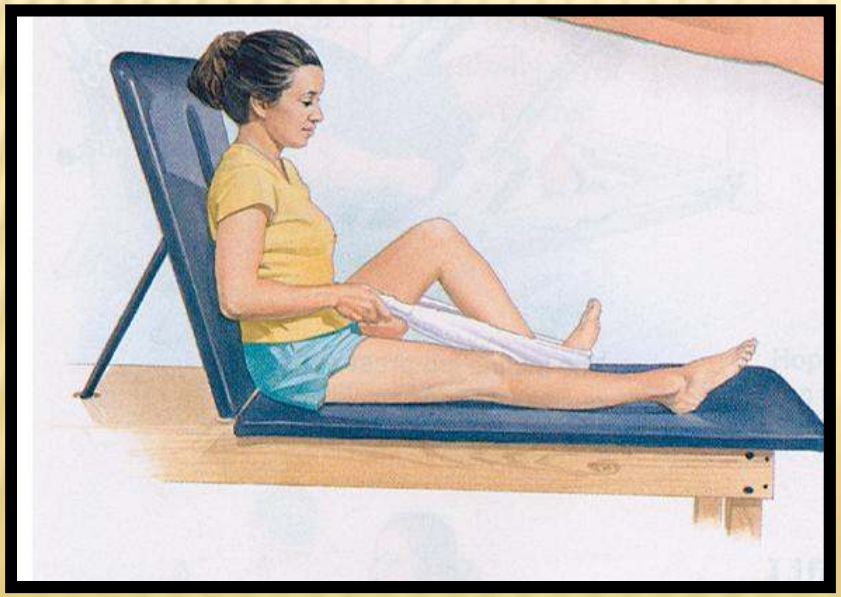
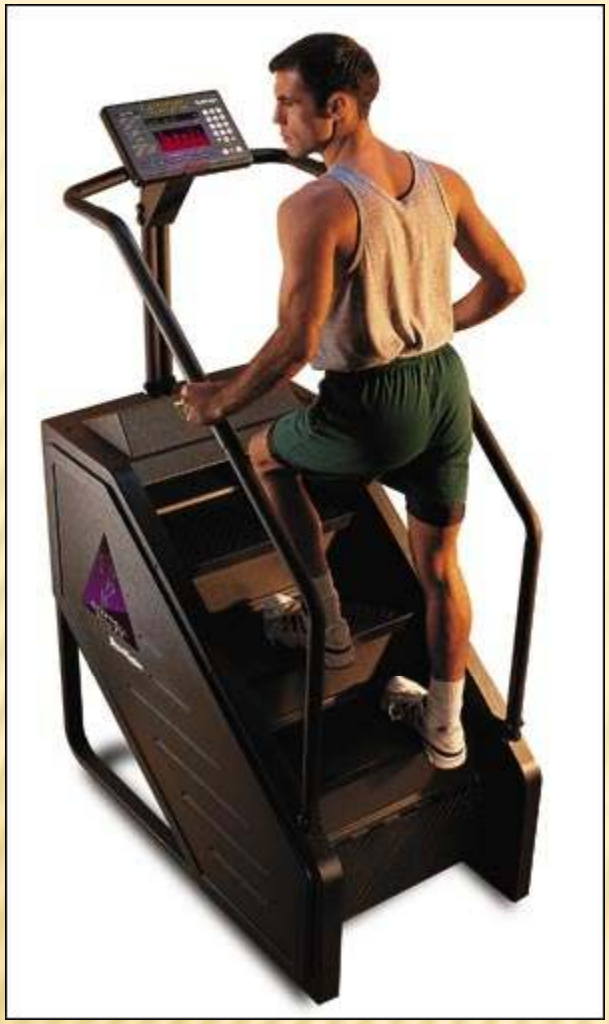


REHABILITATION

WEEK 4:

- Non weight bearing
- Quadriceps and Hamstring isometrics
- Straight leg raises
- Electrical muscle stimulation
- Pool exercises (hip and ankle)
- Stationary bike
- Stairmaster

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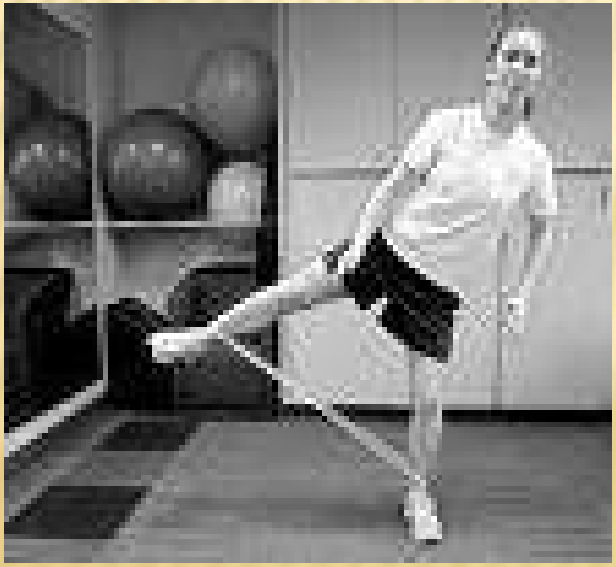
REHABILITATION

WEEK 6:

- Non weight bearing
- Quadriceps and Hamstring isometrics
- Straight leg raises with weight
- Hamstring curls
- Hip progressive resistance exercises
- Pool ROM
- Cycling for ROM



REHABILITATION

WEEK 8:

- Begin weight bearing
- ROM should be 0 and 110 degrees
- Cycling
- Hamstring curls
- Jump rope
- Swimming


HUMANA

REHABILITATION

3 MONTHS:

- ROM 0 and 125 degrees
- Treadmill walking
- Cycling
- Quarter squats
- Sport specific skills


THE
CLINIC


Exercises to Prevent and Address ACL Injuries
PLAY

REHABILITATION

4 - 6 MONTHS:

- ROM 0 and l40 degrees
- Treadmill walking
- Isotonic knee extensions
- Isokinetics when 10% of body weight can be done isotonically (90-240 degrees/second)
- Step-ups

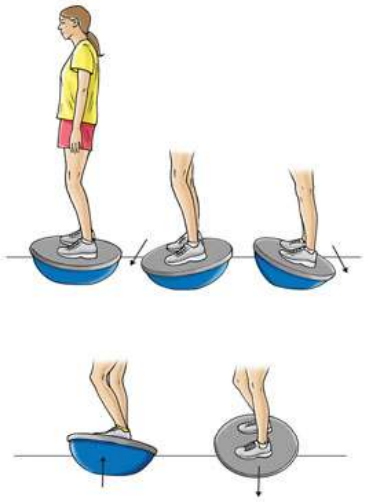

BIODEX

REHABILITATION

6 MONTHS:

- Test isokinetically
- Begin terminal knee extension
- Running (straight ahead)

Anterior Cruciate Ligament (ACL) Injury Rehabilitation Exercises

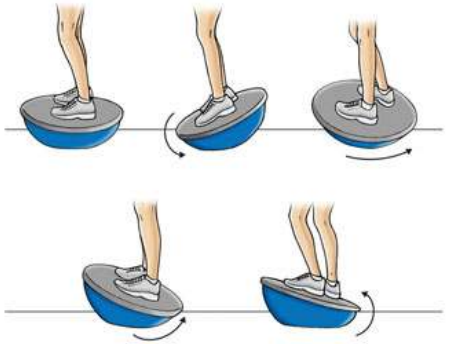


Wobble board exercise: A

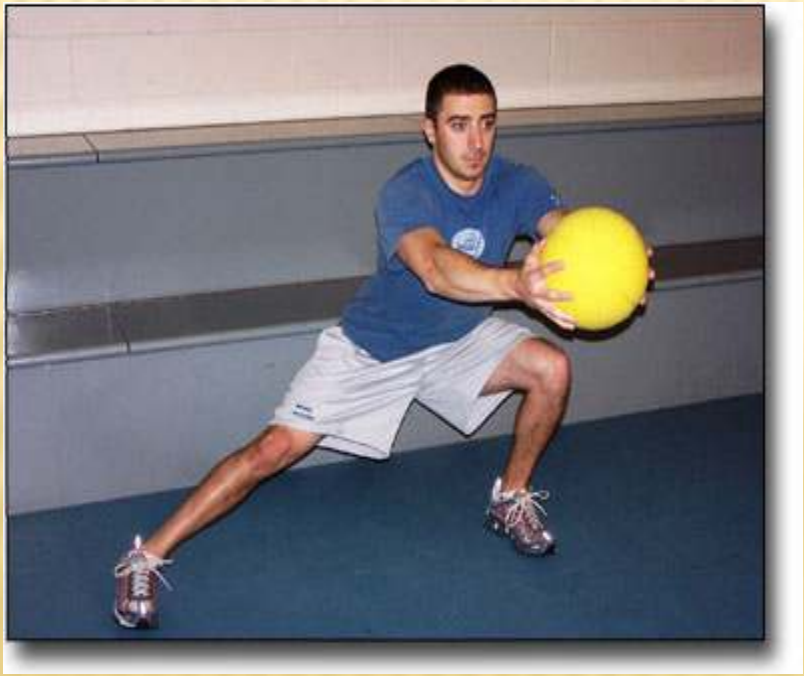
Wobble board exercise: B

Wobble board exercise: C

Wobble board exercise: E

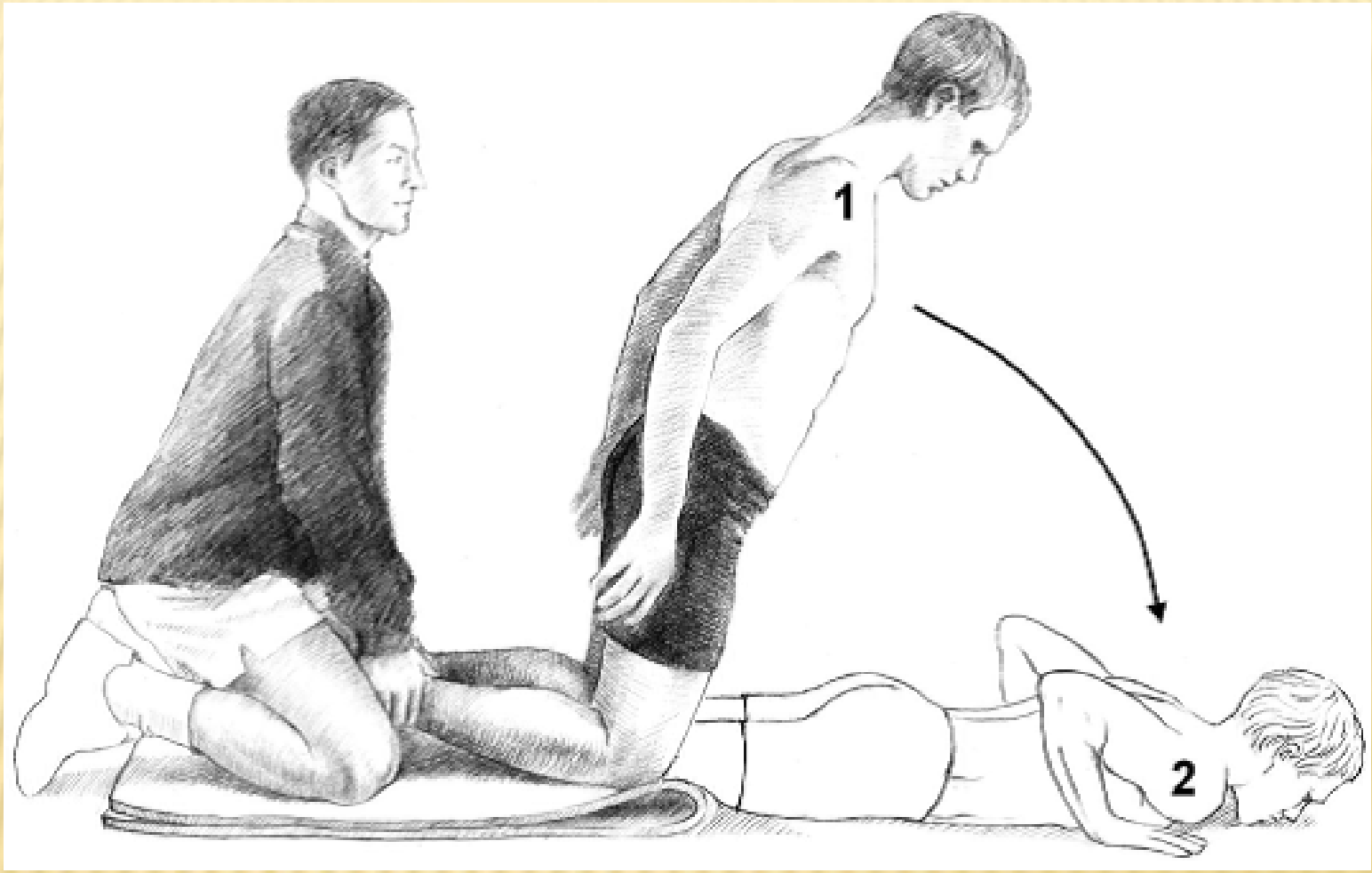


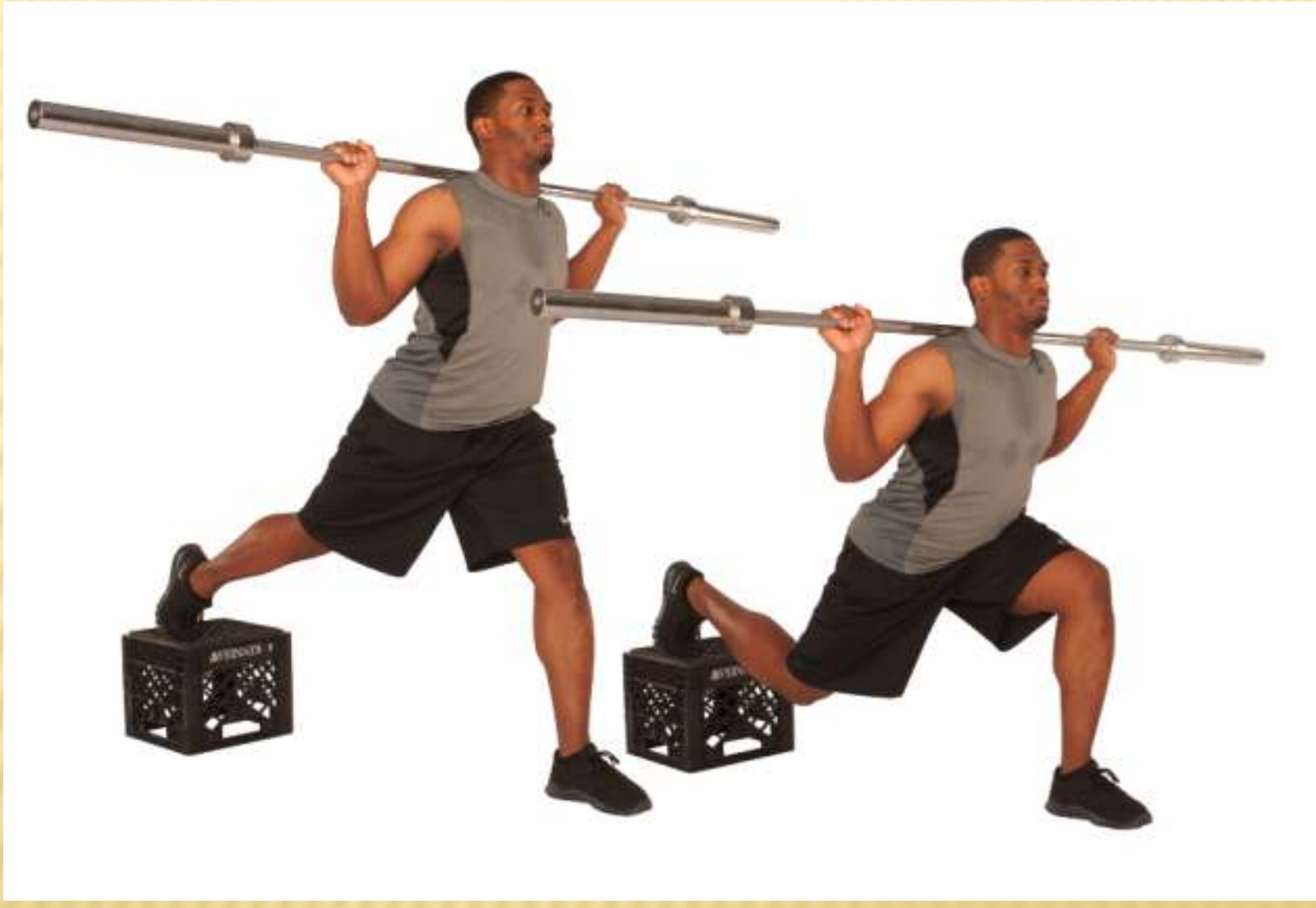
Wobble board exercise: D




It is best to do this with a weight around the ankle and trying to press the side of

Nordic hamstring lower





Thanks