

# Anterior Cruciate Ligament Injuries

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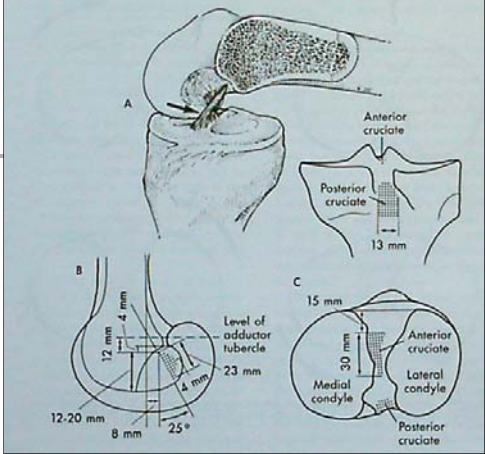
## Introduction

### ■ ACL Injuries

- 1 in 3,000 people in the US each year
  - 120,000 to 200,000 new injuries per year
  - >100,000 reconstructions per year
    - 6<sup>th</sup> most common procedure performed by ABOS Examinees
- Miayasaki et al: Am J Knee Surg, 1991*  
*ABOS Report, 2003*
- Rising injury numbers in:
    - middle-aged athletes
    - females
    - extreme athletes

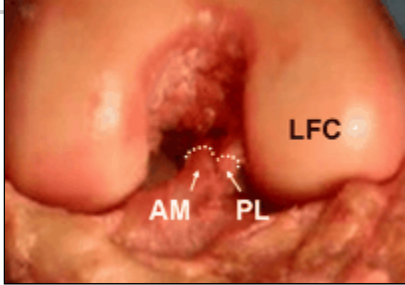
## Anatomy

- ACL - Anatomy
  - 33mm in length
  - 11mm in width
  - Tibial insertion
    - diamond shaped in front of intercondylar eminence
  - Femoral insertion
    - semicircular on the posteromedial aspect of lateral femoral condyle



## Anatomy

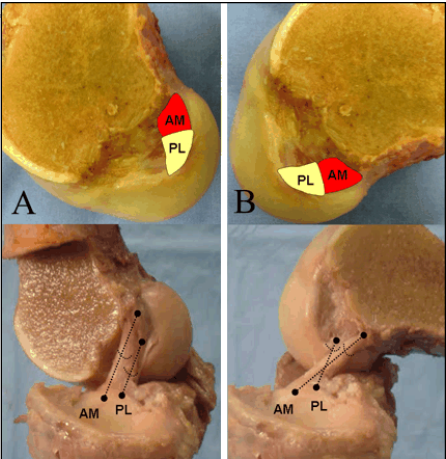
- ACL – Functional Anatomy
  - Anteromedial Bundle
    - Longer and slightly larger
    - Tight in flexion
    - Primary stabilizer to anterior translation



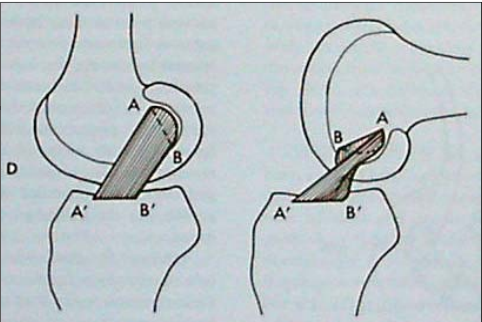
## Anatomy

### ACL – Functional Anatomy

- Posterolateral Bundle
  - Tight in extension
  - Primary stabilizer to rotation
  - Maybe more important?

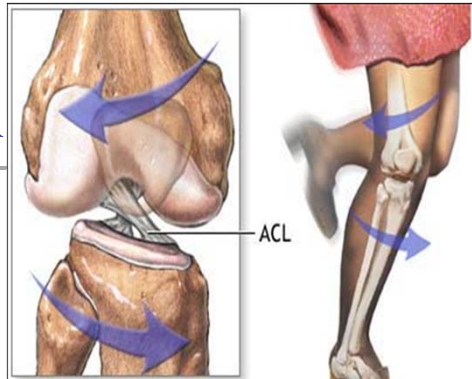


## Introduction



- ACL - Function
  - Mechanical
    - Primary restraint to anterior translation of tibia
    - Resists hyperextension and excessive internal rotation
    - Secondary varus/valgus stabilizer
  - Proprioceptive
    - Feedback system for muscle control about knee

## Introduction



### ■ Mechanism

- Most are non-contact injuries
- Twist and deceleration
- Associated with a “pop”
- Immediate swelling
- Able to walk off the field
- Not able to continue to play

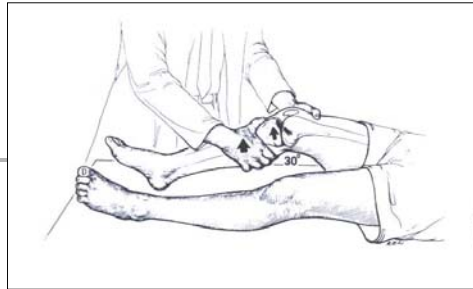
## Introduction

### ■ ACL Injuries – Mechanism



***Bottom Line: Pop and immediate swelling is an ACL injury until proven otherwise***

## Introduction



- ACL Injuries – Physical Exam
  - Most information in the acute setting (Prior to pain and spasm)
  - Lachman: most sensitive
  - Pivot shift
  - KT-1000 arthrometer > 3mm difference is significant

## Introduction



- Lachman Test

## Introduction



- Pivot Shift Test

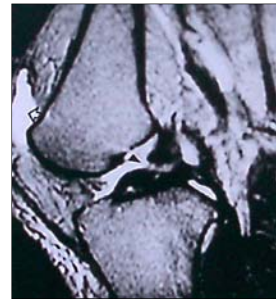
## Imaging



- ACL Injuries – Imaging
  - Radiographs
    - Hemarthrosis
    - Segond Fracture “Lateral capsular sign”

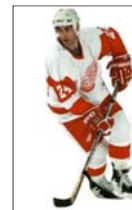
## Imaging

- ACL Injuries – Imaging
  - MRI
    - Modality of choice
    - Check for associated injury
      - Meniscus
      - Other Ligaments
      - Articular Cartilage
      - Bone Bruises???



## Treatment

- ACL Injuries – Who needs surgery?





## Treatment

- ACL Injuries – Who needs surgery?
  - Current recommendations
    - Athletically active patient wishing to continue cutting, jumping and pivoting sports
    - Active patients with associated reparable meniscus tear
    - Active patients with other major ligamentous injury
    - Patients experiencing instability with activities of daily living
    - ? Mild-Moderate DJD with Instability?

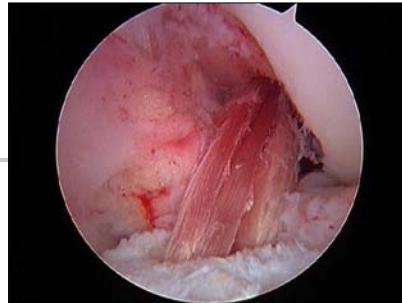
## Treatment

- ACL Reconstruction
  - Goals
    - Regain stability
    - Protection of meniscus and articular cartilage
    - Unclear that reconstruction alters the natural progression of osteoarthritis

*Clatworthy: Clinics in Sports Medicine, 1999*

- Reduce activity related pain and instability in the early arthritic knee

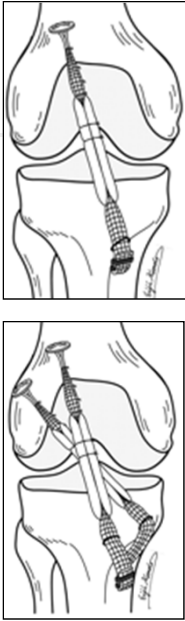
*W Lowe: Baylor College of Medicine, 2004*






## Treatment

- Evolution of ACL Reconstruction
  - Deal with it.....
  - Extra-Articular Reconstruction
  - Intra-Articular Reconstruction
    - Refined Tunnel placement
    - Multiple Fixation options
    - Choice of graft
    - Double Bundle
    - Healing Mediators/Potentiators





## Treatment

- Evolution of ACL Reconstruction
  - Despite this.....
  - 30-40% may fail clinically or are unable to regain prior level of activity
    - Freedman et al: AJSM, 2003*
    - Biau et al: CORR, 2007*
  - Could we have prevented this?????

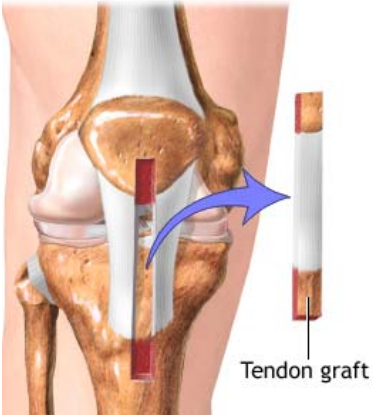


## Treatment

- Evolution of ACL Reconstruction
  - Despite this.....
  - Up to 90% with some DJD by 7 years
    - Bouncristani et al: Arthrosc, 2007*
    - Fithian et al: AJSM, 2005*
  - Could we have prevented this??????

## Graft Options

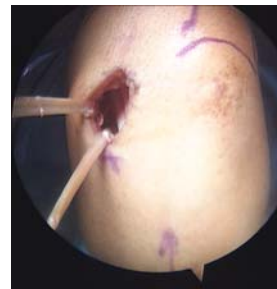
- ACL Reconstruction - Graft choice
  - Bone – PT – Bone
    - Pros:
      - Gold Standard
      - Incorporation
      - Rigid Fixation
    - Cons:
      - Donor Site Morbidity
      - Peri-Op Pain



Tendon graft

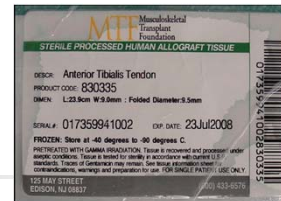
## Graft Options

- ACL Reconstruction - Graft choice
  - Hamstring Autograft (ST and Gracilis)
    - Pros:
      - Ease of Surgery
      - Variability
      - Auto Tissue
    - Cons:
      - Fixation/Incorporation
      - Laxity?
      - Donor Site Morbidity



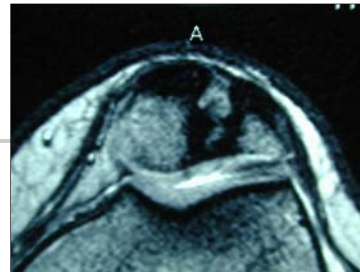
## Graft Options

- ACL Reconstruction - Graft choice
  - Allograft
    - Achilles Tendon
    - Tibialis Tendon
    - Patella Tendon
    - Hamstring – Gracilis and SemiT
    - Quad Tendon



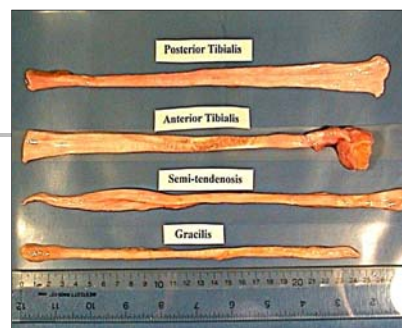
## Graft Options

- Allograft Pros:
  - No donor site morbidity
  - Speed/Ease of preparation
  - Customized for revision surgery
- Allograft Cons:
  - Disease transmission
  - Graft Tunnel healing issues



## Graft Options

- Soft Tissue Allografts
  - Concerns about bone to bone healing and fracture in bone containing allografts
  - Easy to prepare and pass
  - Improved soft tissue graft fixation
  - Better for older individuals



## Graft Strength

Graft Biomechanics (Harner, Noyes, Haut et al, 45th ORS)

Graft	Failure Load (N)	Stiffness (N/mm)
Semi-T/Gracilis Auto	4108 $\pm$ 585	954 $\pm$ 105
Achilles Allograft	2879 $\pm$ 571	418 $\pm$ 84
Quad Tendon Autograft	4090 $\pm$ 295	776 $\pm$ 204
Ant. Tib. Allograft	4122 $\pm$ 893	625 $\pm$ 15
BTB Allograft	3594 $\pm$ 1330	511 $\pm$ 184
BPTB Autograft	2977 $\pm$ 260	685 $\pm$ 86
Native ACL	1725 $\pm$ 269	282 $\pm$ 28

## Treatment

### ■ Conservative Treatment

- PT
- HEP
- NSAID's
- Brace
- Activity Modification





## Treatment

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- Surgery Steps

- Education
- Consent
- Set-Up
- EUA
- Diagnostic Scope
- Associated Pathology




## Treatment

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- Surgery Steps

- Graft Harvest/Prep
- Femoral Tunnel
- Tibial Tunnel
- Clean Knee
- Pass Graft
- Fix Graft
- Final Assessment



# Surgery

- Surgery Steps
  - Education
  - Consent

**Patient Education – ACL Injuries**

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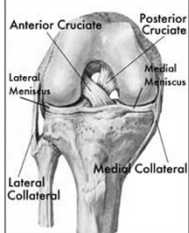
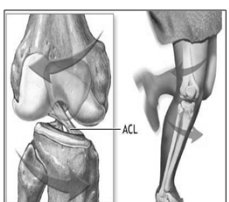
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**History**


The Anterior Cruciate Ligament (ACL) is a main stabilizer of the knee. It works to prevent anterior translation of the tibia on the femur predominantly at 0-30 degrees of flexion. Approximately 30mm in length and 11mm wide, it runs from a narrow insertion on the lateral femoral condyle to a broader, diamond-shaped insertion anterior to the intercondylar eminence of the tibia. The ACL can be seen in the knee drawing below and on the left. It is essential in allowing the knee to withstand the forces experienced in aggressive running, cutting, and jumping type activities.

The majority of ACL tears are non-contact in nature. This can occur from deceleration, such as when landing from a jump, or cutting activities which force the knee into excessive flexion, valgus, and rotation. A schematic detailing the common injury pattern can be seen below to the right. The female athlete has a higher incidence of ACL injury as there are a few factors that we have shown to contribute to this. In general, females have increased flexibility and laxity in the tissues around the knee, the femoral notch is narrower, they have more valgus and tibial torsion about the knee, and females have more difficulty in recruiting their hamstring muscles to help prevent excess anterior tibial translation. All of these things contribute to making the female athlete more at risk for ACL injuries and are modified as much as possible during the post-op rehabilitation.


Basic Knee Anatomy
Common Injury Pattern for ACL Tear

ACL injuries can be diagnosed with clinical exams, via increased laxity of the tibia, shin bone, on the femur, the thigh bone. Plain X-Rays should be performed in all knee injuries to rule out the possibility of fracture or growth plate injury in the younger athlete. A magnetic resonance image or "MRI" should also be done on all suspected ACL injuries, not only to document the presence of a ligament tear, but also to evaluate for the possibility of meniscus injury, articular cartilage injury, or other



# Surgery

- Surgery Steps
  - Set-Up
  - EUA
  - Diagnostic Scope





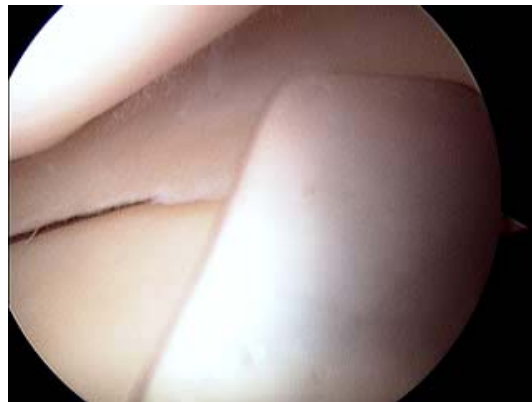
## ACL Reconstruction

- Partial Medial Menisectomy



## ACL Reconstruction

- Partial Lateral Menisectomy



## ACL Reconstruction

- Removing Old ACL



An arthroscopic view of the knee joint. The image shows the femoral condyle and the tibial plateau. A dark, fibrous structure, likely the old ACL, is visible and being manipulated. The surrounding tissue is pinkish-red, indicating a surgical site.

## ACL Reconstruction

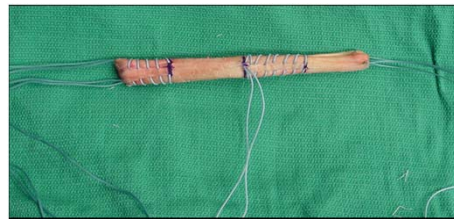
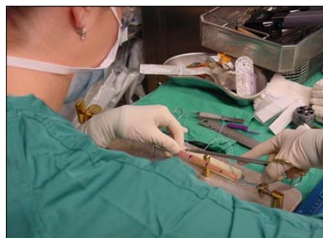
- Graft Harvest



An arthroscopic view of the knee joint. The image shows the femoral condyle and the tibial plateau. A dark, fibrous structure, likely the old ACL, is visible and being manipulated. The surrounding tissue is pinkish-red, indicating a surgical site.

## ACL Reconstruction

- Graft Prep
  - Assistant
  - 90-100mm long
  - 7-11mm diameter



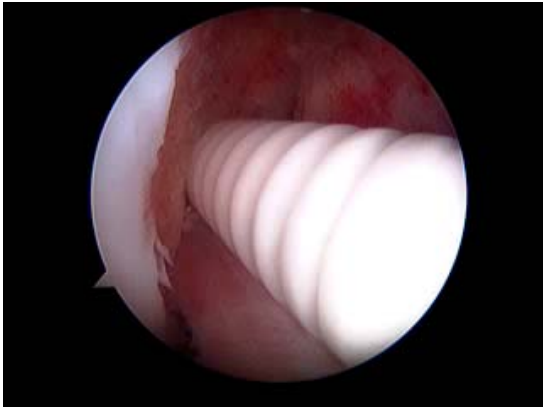
## ACL Reconstruction

- Hyperflex knee and drill Femoral Tunnel
  - 10 or 2 o'clock
  - Aiming for 1-2mm back wall
  - First with 4.5 reamer
    - Depth
    - Facilitate suture passage
  - Drill Final Femoral Tunnel
    - Average Diameter – 8.52 mm



## ACL Reconstruction

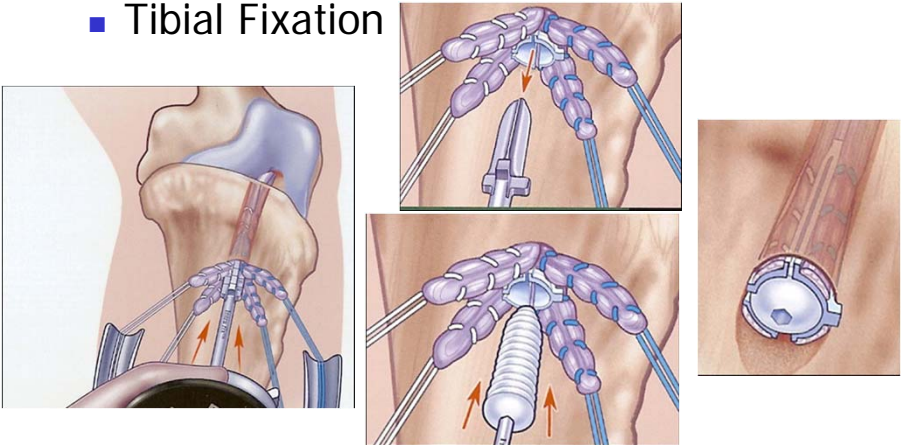
- Screw Placement



An arthroscopic view showing a white, threaded screw being inserted into the tibia. The screw is positioned within a tunnel, and the surrounding tissue is visible in shades of red and pink.

## ACL Reconstruction

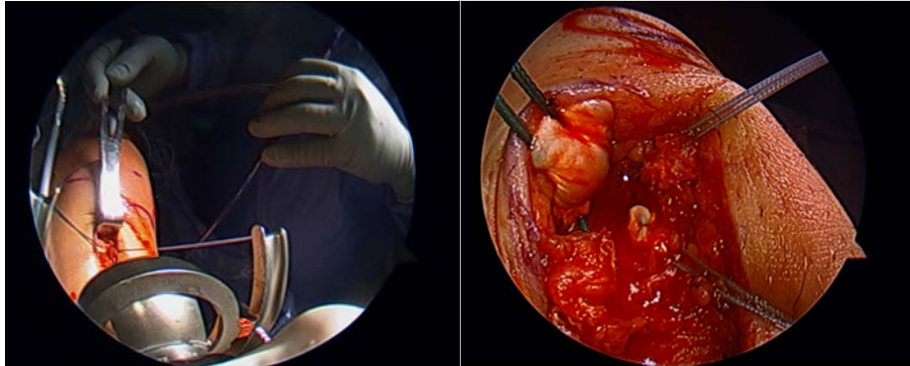
- Tibial Fixation



A series of diagrams illustrating tibial fixation techniques for ACL reconstruction. The top-left diagram shows a knee joint with a graft and a fixation device. The middle-left diagram shows a close-up of the graft and fixation device. The middle-right diagram shows a close-up of the graft and fixation device. The bottom-right diagram shows a close-up of the fixation device.

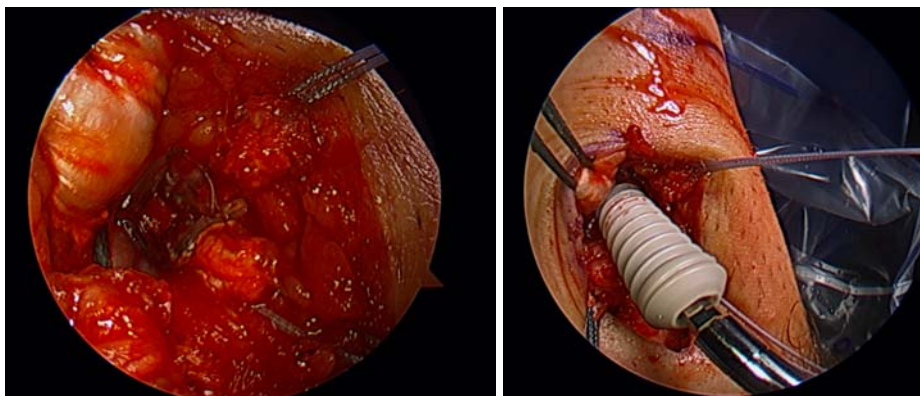
## ACL Reconstruction

- Tibial Fixation



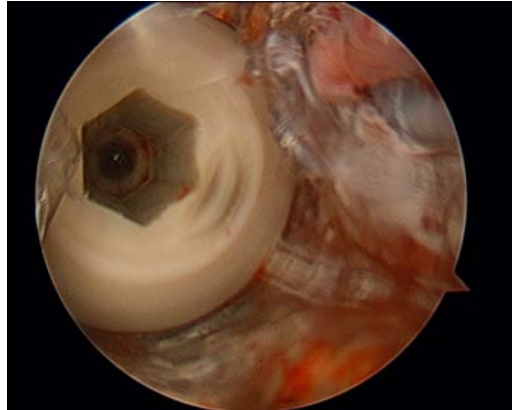
## ACL Reconstruction

- Tibial Fixation



## ACL Reconstruction

- Tibial Fixation



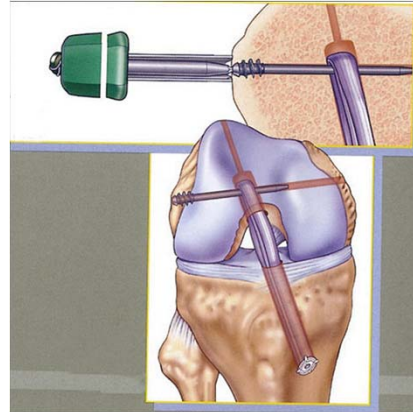
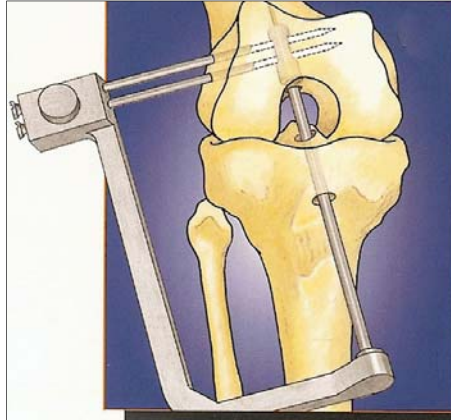
## ACL Reconstruction

- Inserted Graft



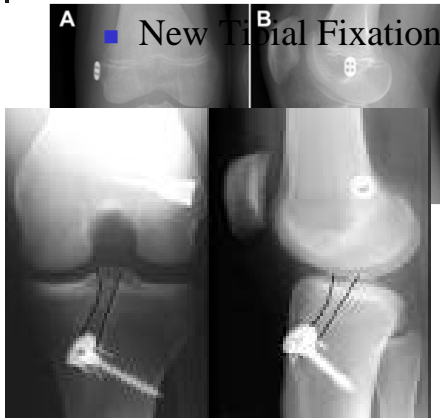
## ACL Reconstruction

- Newer Femoral Fixation Options



## ACL Reconstruction

- New Tibial Fixation Options





## Post-Operative Course/Rehabilitation

- Outpatient Surgery
- IV Antibiotics before surgery (2gm Ancef)
- Initial P.T. visit on POD #2-3
- Emphasize Early ROM
- Early WBAT (IROM unlocked at 10-14 days)
- Functional Brace at 6 weeks
- Jogging at 12-16 weeks
- Light Sports Specific training at 16-18 weeks
- Running and Cutting at 26-28 weeks

# Thank You

