

## Complications Following ACL Surgery & Rehabilitation:

### Rehabilitation Strategies

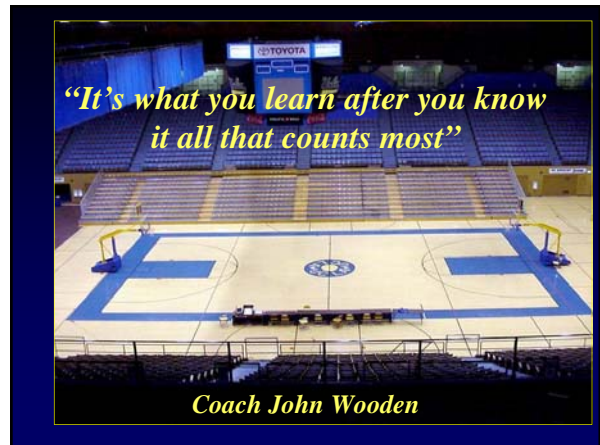
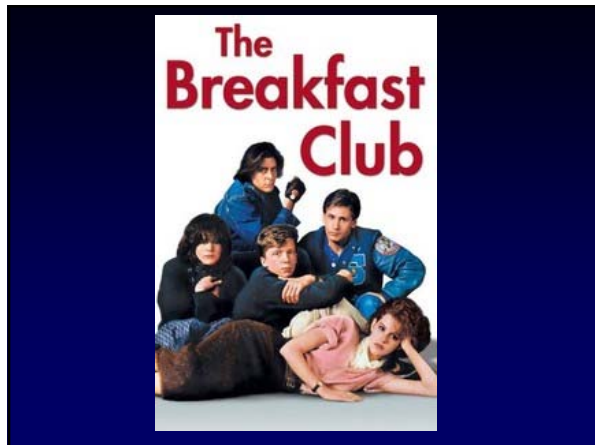
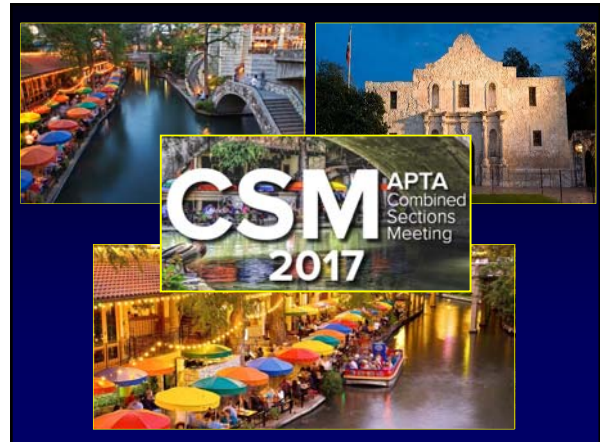


Physiotherapy Associates

**CSM**  
CHAMPION  
SPORTS MEDICINE

Kevin E. Wilk, PT, DPT

**ASMI**



## Complications Post ACL Recon

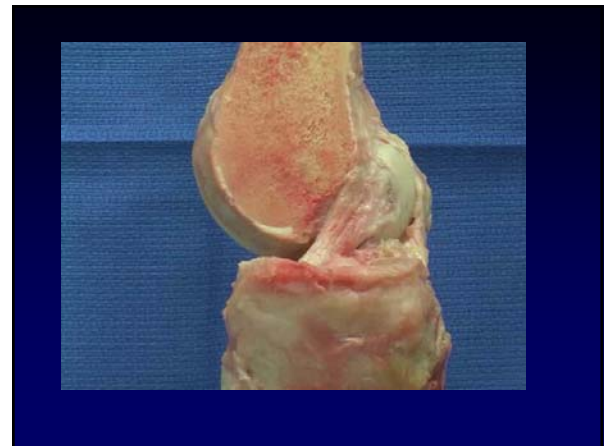
### Discussions Points

- ✓ Knee stiffness
- ✓ Quadriceps atrophy
- ✓ Valgus knee collapse
- ✓ Varus alignment
- ✓ Increased post-op graft laxity
- ✓ Revision ACL



Treatment Strategies to Eliminate These Post-Op Complications





**JOSPT '12**

**Recent Advances in the Rehabilitation of Anterior Cruciate Ligament Injuries**

**OCNA '03**

**Recent advances in the rehabilitation of isolated and combined anterior cruciate ligament injuries**

**J Engineering Med '12**

**Cruciate ligament loading during common knee rehabilitation exercises**

**Managing Knee Injuries: Keeping Up With Changes**

**JOSPT '12**

**Anterior Cruciate Ligament Strain and Tensile Forces for Weight-Bearing and Non-Weight-Bearing Exercises: A Guide to Exercise Selection**

**JOSPT '15**

**We Can Do Better**

**Rehabilitation Principles of the Anterior Cruciate Ligament Reconstructed Knee**

**Twelve Steps for Successful Progression and Return to Play**

**KEYWORDS**

- Proprioception • Neuromuscular training • Return to play • Functional rehabilitation

**KEY POINTS**

- Rehabilitation after anterior cruciate ligament reconstruction is a gradual and progressive program.
- Active, adaptive and appropriate use objectives criteria to advance from one phase to another.
- Functional restoration of full knee extension and flexion after surgery.
- Stabilization for the knee joint occurs from above (hip) and from below (ankle).
- Use objective criteria to progress a patient to return to sports activities.

**Clin Spts Med '17**

**Box 1**

**Twelve steps critical for successful anterior cruciate ligament rehabilitation:**

1. Preparation of both the patient and their knee for surgery
2. Reduce full passive knee extension
3. Reduce postoperative inflammation
4. Strainal restoration of full knee flexion
5. Reduce complete passive swelling
6. Individualize and adjust the rehabilitation program based on the status of the knee
7. Reestablish quadriceps activation
8. Restoration of dynamic functional stability of the knee complex
9. Knee stability and dynamic control must be provided from both above and below
10. Protect the knee joint over and over
11. Objective return to training
12. Objective progression beyond training and back to sport

## Complications Following ACL Surgery

### Introduction

- Significant advancement in past decade
  - » Surgical advancements
    - ✓ Arthroscopy – less scarring
    - ✓ Improved fixation
    - ✓ Concomitant injuries
    - ✓ Delaying surgery
    - ✓ Improved surgical technique

## Complications Following ACL Surgery

### Introduction

- Significant advancement in rehabilitation protocols
  - » Immediate motion
  - » No immobilization
  - » Early functional activities
  - » Early WB activities

## ACL REHABILITATION

### Previous Rehabilitation Approach

- ✓ Immobilization 6 - 8 weeks  
– cast or brace
- ✓ Restricted motion
- ✓ Delayed weight bearing  
(8 - 12 weeks)
- ✓ Prolonged rehabilitation  
(9 - 12 months)
- ✓ No sports for 12 months



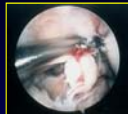
All these advancements have contributed to greater success rates

But complications can & do occur



## What's the worst complication following ACL reconstruction ??

- Graft failure/rupture
- Stiffness/loss of motion
- Infection
- Looseness (i.e. graft stretch-out)
- Muscular weakness
- Patellofemoral pain
- Patellar fracture



*Puterbaugh, Jain, Ma, et al. AJSM '12*

• All knees in 40 patients (25 ACLR, 15 RCL) were 90°

• 50% of knees of initial injury then normally for a maximum of 11 yrs

• All knees measured normal (normal) range

• Risk of cartilage loss doubled from 1.4 for the lateral & medial compartments & 1.4 for patella

• In 7 yrs 11 yrs 13 yrs 15 yrs 17 yrs

• Size of the knee bones associated for degeneration from 1.4 to 2.1

**Knee Wear – Osteoarthritis**

## ACL Reconstruction

### Graft Options

- ✓ Autogenous
- ✓ Allograft
- ✓ Prosthetics / Synthetics
- ✓ Bio-prosthetics



## Ultimate Load to Failure & Stiffness of ACL Grafts

	Ultimate Strength to Failure	Stiffness
Native ACL	2160 N	242 N/mm
<i>Noyes et al: JBJS '84</i>	<i>Woo et al: AJSM '91</i>	
Native PCL	2867 N	
Patellar Tendon Graft	2977 N	455 N/mm
<i>Cooper et al: AJSM '93</i>		
Quadrupled STG	4090 N	776 N/mm
<i>Hamner et al: JBJS '99</i>		
Quad Tendon Graft	2174 N	463 N/mm
<i>Staubli et al: AJSM '99</i>		
Achilles Tendon Graft	4617 N	685 N/mm
<i>Wren et al: Clin Biomech '01</i>		

## Complications Following ACL Surgery

### Overview

- Types of complications dependent on graft source, surgery, etc.
- ✓ Autogenous PTG:
  - Patellar fracture
  - Patellar tendon rupture
  - Patellofemoral pain
  - Quadriceps weakness
  - Donor site pain



## Complications Following ACL Surgery Overview

- **Autogenous STG:**
  - ✓ Donor site pain
  - ✓ Hamstring weakness
  - ✓ Fixation "stretchout"
- **Allograft tissue:**
  - ✓ Graft "stretchout"
  - ✓ Late failure
  - ✓ Disease transmission



## Pallis et al: AJSM 2012

- Survival comparison of allografts vs. autografts in ACL reconstruction in the US Military Academy
- Members of classes 2007-2013
- 122 ACL reconstructions in 120 cadets (2 bilateral)
  - 61 ACL/PTG
  - 45 ACL/STG
  - 16 allografts
- ✓ 20 failures occurred
  - ✓ 7 ACL/PTG 11%
  - ✓ 7 Allografts 44%
  - ✓ 6 ACL/STG 13%
- ✓ Allografts 7.7x more likely to experience graft failure



### Allograft Versus Autograft Anterior Cruciate Ligament Reconstruction

**Predictors of Failure From a MOON Prospective Longitudinal Cohort**

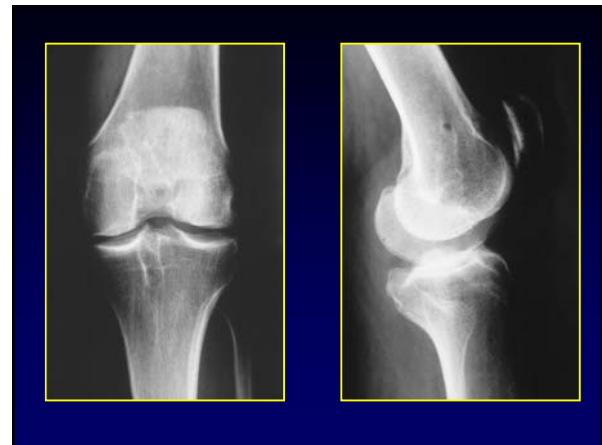
Christoffer C. Leardini, MD<sup>1</sup>, Brian Cole, MD<sup>2</sup>, Joseph Pappas, MPH<sup>3</sup>, Eric Fong, MD<sup>4</sup>, Jonathan Aronow, MD<sup>5</sup>, Jack T. Aronow, MD<sup>6</sup>, James R. Dorn, MD, MPH<sup>7</sup>, Robert D. Maerz, MD<sup>8</sup>, Eric C. Meebals, MD<sup>9</sup>, Robert D. Finkel, MD<sup>10</sup>, Fred W. Struss, MD<sup>11</sup>, and Kurt J. Swanson, MD<sup>12</sup>

**JSH '11**

- ✓ Multi-center center MOON
- ✓ 4x higher risk of ACL allograft rupture than autograft
- ✓ Age 10-19 highest failure rate
- ✓ Each 10 yr decrease in age, odds of graft rupture increases by 2.3x

**Clinical Relevance:**

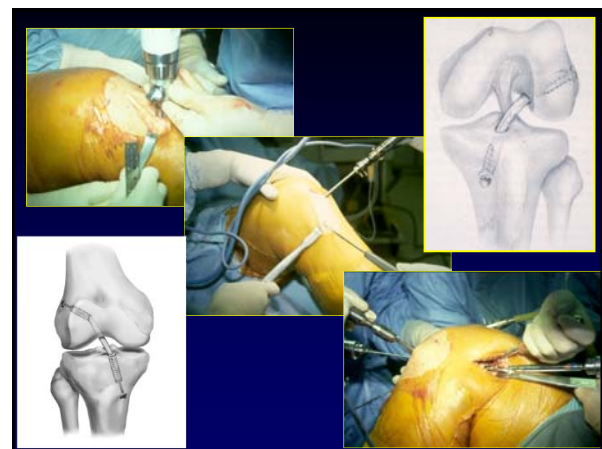
Given these risks for ACL graft rupture, allograft ACLRs should be performed with caution in the younger patient population.



## The Most Common Reason For Graft Failure







Anterior Cruciate Ligament



## ACL Reconstruction

### Graft Placement




- **Number 1 cause of revision surgery**
- Meticulous attention to femoral placement
  - » Posterior
    - ✓ 6 mm anterior to posterior cortex
  - » Notch side wall
    - ✓ 1:30 / 10:30 position

## ACL Reconstruction

### Overview

- ✓ *Common procedure*
- ✓ 100,00 ACL reconstructions annually
- ✓ 85% of all ACL reconstruction performed by Orthopaedists who perform less than 10/yr


## Complications Post ACL Recon

### Discussions Points

- ✓ **Knee stiffness**
  - ✓ early loss of motion – 2 weeks PO
  - ✓ late loss of motion – 8-9 wks PO
- ✓ Quadriceps atrophy
- ✓ Valgus knee collapse
- ✓ Varus alignment
- ✓ Increased post-op graft laxity

*The Best Treatment Strategies*

## Complications Post ACL Recon

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*The Best Treatment Strategies*

## ACL/STG Recon 2 wks PO

- PROM 0-10-115
- Partial lateral meniscectomy
- Anterior knee pain
- Swollen 3.5cm ↑
- Quad inhibition
- ???

## ACL/STG Recon 2 wks PO

- ✓ PROM 0-10-115
- ✓ Treatment Strategies:



## Post-Op ACL/PTG Patient

- 8 weeks post-op ACL/PTG surgery
- Present motion: 0-20-90°
- Lateral meniscus repair
- Knee joint normal otherwise
- *Any additional information would be helpful?*
  - contralateral knee joint PROM (7-0-147)
  - surgery timing (injury to surgery)
  - concomitant injuries (medial capsule, MCL)

## ACL/PTG 8 weeks PO

- Treatment:

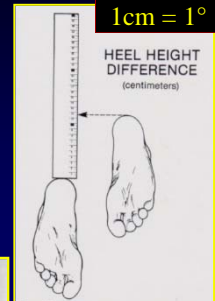
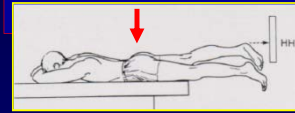
- ✓ \_\_\_\_\_
- ✓ \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_



## Loss of Knee Motion

### Loss of Extension

Correlation between loss of knee motion and PF Pain  
Sachs, Daniel, et al: AJSM '89



Patellofemoral problems after anterior cruciate ligament reconstruction\*

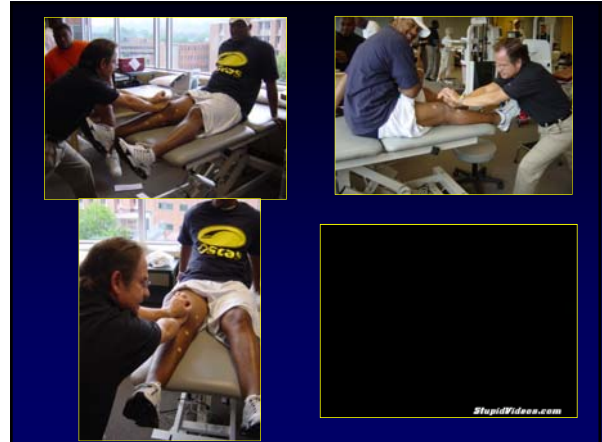
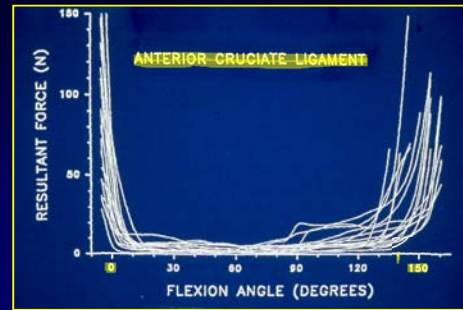
RAYMOND A. SACHS,† MD, DALE M. DANIEL, MD, MARY LOU STONE, RPT, AND RICHARD F. GARFIN

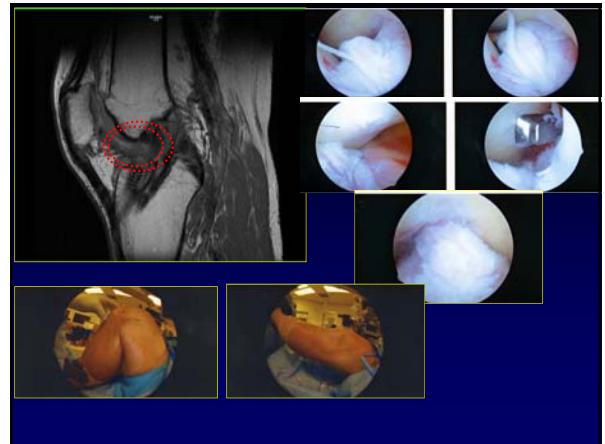
Figure 1. Heel height difference is measured in centimeters with the patient prone. As a quick estimate, each centimeter of heel height difference is equal to one degree of knee flexion.

## What About Restoring Hyperextension?



## ACL Strains at ROM Extremes



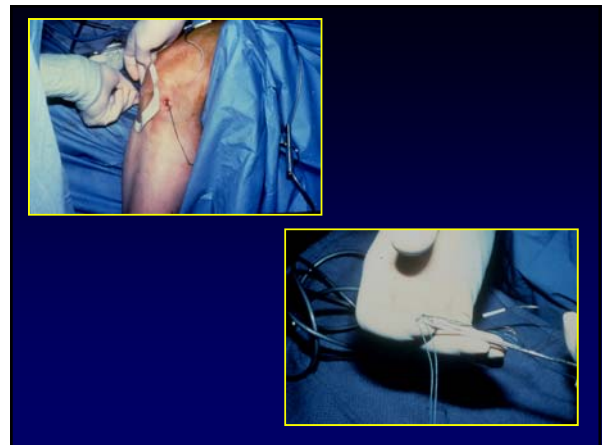


## PRINCIPLES OF ACL REHAB

### ACL Strain

- ACL strain during motion
- ✓ Passive ROM
- ✓ Active ROM
- Resisted movements

The graph plots ACL strain (%) on the y-axis (ranging from -8 to 4) against Knee Flexion Angle (Deg) on the x-axis (ranging from 0 to 120). Two curves are shown: APROM (Active Range of Motion) and PRON (Passive Range of Motion). The APROM curve starts at approximately 2% at 0 degrees, peaks at about 4% at 20 degrees, and then gradually decreases to about 0% at 120 degrees. The PRON curve starts at approximately -2% at 0 degrees, reaches a minimum of about -6% at 40 degrees, and then gradually increases back to about -2% at 120 degrees. The graph is labeled '(N=10)' and 'STRAIN VALUES - MEAN ± SD'.



## Keys To Rx Knee Stiffness

### Early Interventions

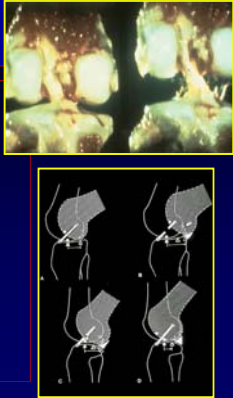
- ✓ Patellar mobilizations
- ✓ Activate quads
- ✓ Overpressure in extension  
*Hyperextension is the goal*
- ✓ Gradually increase flexion
- ✓ Calm the knee joint down  
*Reduce inflammation/swelling*
- ✓ Ambulation in drop lock brace

Two photographs showing early interventions for knee stiffness. The top photo shows a person sitting on a table with their knee flexed, being assisted by a therapist. The bottom photo shows a person lying on a table with their knee flexed, being assisted by a therapist.



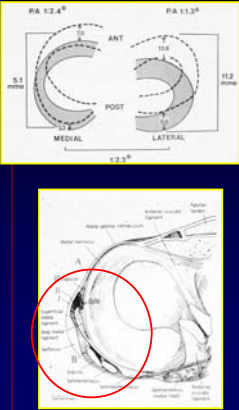
## Loss of Motion Unidirectional

- Graft placement – anterior placement
- Rehab plan
  - Gradually increase flexion
  - Increase in laxity
  - Stretch, AAROM, PROM, bicycle
  - Joint mobs (posterior, when appropriate)
  - Extension



## Loss of Motion Unidirectional

- Concomitant surgeries (meniscus repair, MCL)
- ✓ *Excessive soft tissue scarring, capsular, hypomobility, decrease knee motion*
- Rehab techniques: Soft tissue mobilization, stretch hamstrings / quadriceps, laser therapy, motion, motion & more motion



## Loss of Knee Motion *Keys to Treatment*

- *Prevention is the key !!!*
- If complications occur – careful assessment
- Determine cause – treat cause
- Not one approach fits all!!
- Some complications occur in combination




## Treatment of Post-Operative Knee Stiffness *Loss of Motion*

- Arthrofibrosis
- Does everyone with a loss of motion have arthrofibrosis ??
- *Defined as:*
  - » Inflamed “angry” knee
  - » With loss of motion
  - » Loss of knee flexion & extension
  - » Often not swollen but **HOT !!!**
- *May lead to progressive knee degeneration*



## Rehabilitation of Arthrofibrosis *How Aggressive ?*

*Conservative* ↔ *Aggressive*

- ✓ specific treatment program
- ✓ prevention is the key...but
- ✓ patellar mobility
- ✓ reduce inflammation (NSAID, Medrol Dose Pack ,PT)
- ✓ LLLD extension (start & finish)
- ✓ knee flexion ROM 3x
- ✓ Frequent bouts of moderate/light intensity stretching & ROM
- ✓ Cast, brace, night splint, ???




## ARTHROFIBROSIS FOLLOWING ACL SURGERY

- Occurs in 7-11% of patients
    - Harner: AJSM '92
    - Mohitadi: AJSM '91
    - Shelbourne: AJSM '91
  - Defined: LOM due to excessive scarring or contracture
    - » Extension loss of 7° or more
    - » Flexion limited 120° or less
    - » Both by 3 months post-op
- Paulos: LE in Spts Med (Nicholas & Herschman: 1986)



## Shelbourne: AJSM '91

- Arthrofibrosis in acute ACL reconstructions - The effect of timing of surgery
- Retrospective study of 169 acute ACL
  - » 33 patients surgery 0-7 days
  - » 65 patients surgery 8-21 days
  - » 71 patients surgery more than 21 days
- Group I, II higher loss ROM
- Subgroups A & B = acceleration rehab

Group*	ROM*
IA	33
IB	7
IIA	38
IIIB	0

\*Group I: 1986 vs. 1987-1988,  $P > 0.10$  ( $P = 0.1162$ ); Group II: 1986 vs. 1987-1988,  $P < 0.001$  ( $P = 0.0003$ ); 1987-1988, I vs. II,  $P > 0.10$  ( $P = 0.3019$ ).

## Hunter, et al: Arthroscopy '96

- Surgical timing on post-operative motion & stability following ACL
- 185 acute ACL rupture, skiers
- Prospectively assigned to 4 groups:
  - » Surgery within 48 hours
  - » Surgery between 3-7 days
  - » Surgery between 1-3 weeks
  - » Surgery more than 3 weeks
- No significant difference between groups

## Majors, Woodfin, : AJSM '96

- 119 consecutive ACL reconstructions
- Follow-up data on 111 surgeries
  - » 21 early surgery (1-14 days)
  - » 22 delayed surgery (15-28 days)
  - » 68 late surgeries (more than 28 days)
- All patients early and delayed obtained full ROM
- 93% of late surgeries (5 patients not full extension)



## Guerra, Joyce, Wilk et al: AOSSM '96

- Surgical timing on incidence of arthrofibrosis
- ACL/PTG surgery with accelerated rehab
- 571 patients, retrospective analysis (90-94)
    - » 158 acute (less than 2 weeks)
    - » 107 subacute (2-6 weeks)
    - » 306 chronic (greater than 6 weeks)
  - Approximately 4% incidence (3.8, 3.7 & 4.2%)- *incidence rate the same*  
 "Timing of surgery should be individualized"



## Complications Post ACL Recon

### Discussions Points

- ✓ Knee stiffness
- ✓ Quadriceps atrophy
  - ✓ Early quad inhibition
  - ✓ Late quad atrophy
- ✓ Valgus knee collapse
- ✓ Varus alignment
- ✓ Increased post-op graft laxity



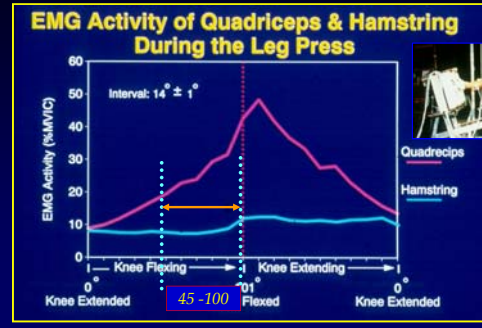
### The Best Treatment Strategies

## Following ACL Reconstruction *Quadriceps Muscle Inhibition*

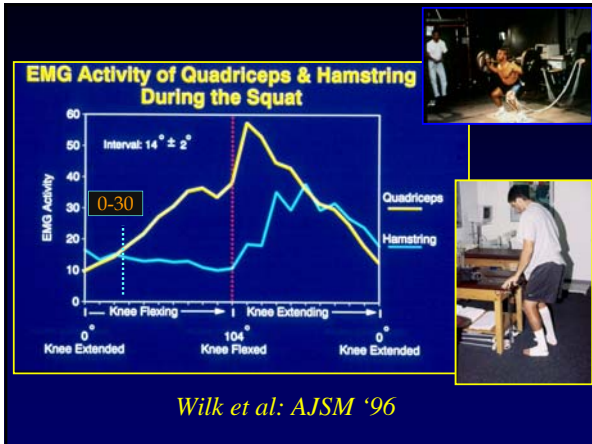
- Quadriceps muscle inhibition during early phase of rehab (first 2-4 weeks)
- Inability to produce good quad isometric
- Quadriceps are atrophied
- ✓ **Best Treatment Strategies:**
- ✓
- ✓
- ✓

## Following ACL Reconstruction *Quadriceps Muscle Inhibition - Early*

- Quadriceps activation:
  - ✓ Quad sets & SLR flexion
  - ✓ EMS quads 60 knee flexion isometrics
  - ✓ Manual resistance short arc knee extension
  - ✓ Other exercises:
  - ✓ Leg Press 45-100°
  - ✓ Wall slides
  - ✓ Biofeedback to quads



Wilk et al: AJSM '94



Wilk et al: AJSM '96

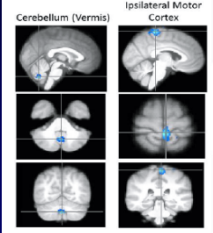



Neuroplasticity associated with Anterior Cruciate Ligament Reconstruction

<sup>1,2</sup>Dustin R. Grooms, <sup>2</sup>Stephen J. Page, <sup>3</sup>Deborah S. Nichols-Larsen, <sup>4</sup>Ajit M.W. Chandhury, <sup>5</sup>Susan E. White, <sup>1</sup>James A. Onate

Regions with Lower Activation in ACL Group Compared to Control

Cerebellum (Vermis) Ipsilateral Motor Cortex

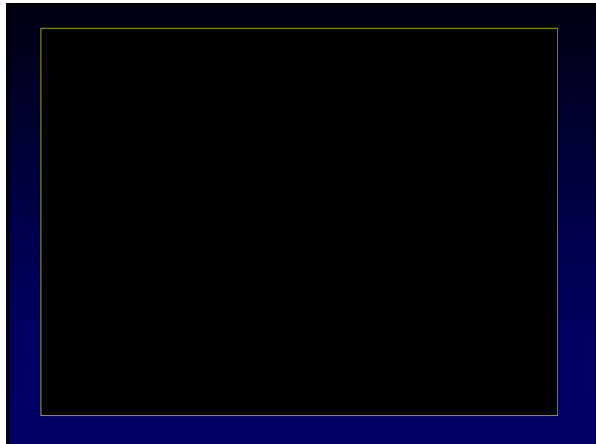
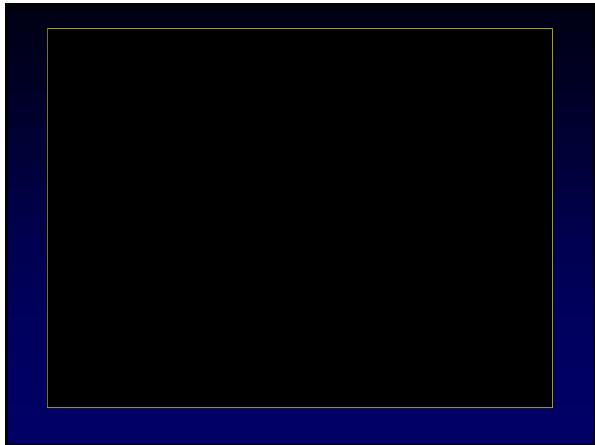
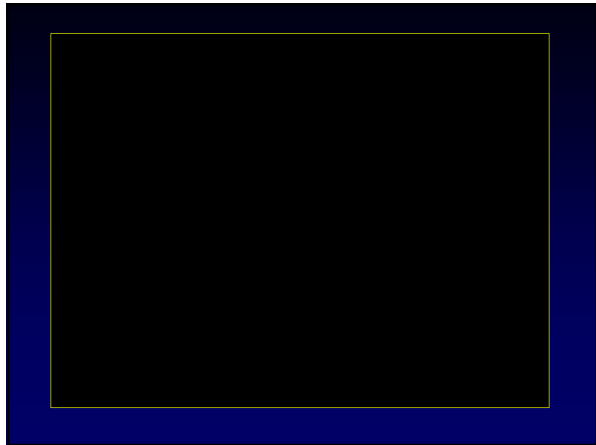



### Following ACL Reconstruction

#### Quadriceps Muscle Inhibition - Late

- Quadriceps Atrophy & Inhibition Present:
- Evaluate quad activation
- If minimal – EMS for muscle re-education
- If muscle contracts but lacks size:
  - ✓ utilize specific exercises
  - ✓ BFR
  - ✓ intensity
  - ✓ protein rich diet




17 yo female  
80% Quad Deficit



### Complications Post ACL Recon

#### Discussions Points

- ✓ Knee stiffness
- ✓ Quadriceps atrophy
- ✓ Valgus knee collapse
  - ✓ Knee injury mechanism
- ✓ Varus alignment
- ✓ Increased post-op graft laxity
- ✓ Revision ACL

The Best Treatment Strategies

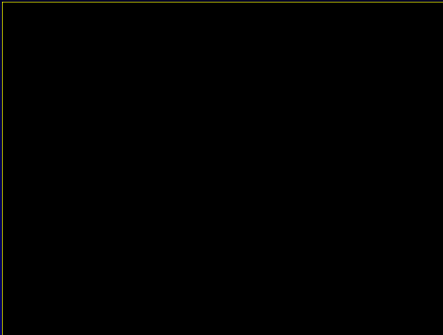


### Following ACL Reconstruction *Valgus Knee Collapse*

- Treatment Options:
  - Assess Q angle
  - Dynamic Q angle
  - Hip abd/ER/Ext strength
  - Core control
  - Movement skills



## Movements with Stabilization



## Complications Post ACL Recon

### Discussions Points

- ✓ Knee stiffness
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- ✓ Valgus knee collapse
  - ✓ Knee injury mechanism
- ✓ Varus alignment
- ✓ Increased post-op graft laxity
- ✓ Revision ACL



### The Best Treatment Strategies

## Following ACL Reconstruction

### Varus Knee Alignment

- Treatment Strategies:
  - ✓ Unloader brace
  - ✓ Orthotics (lateral heel wedge)
  - ✓ Core control exercises
  - ✓ Hip exercises (proximal stab)
  - ✓ Protect medial compartment

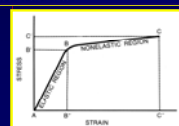


## Complications Post ACL Recon

### Discussions Points

- ✓ Knee stiffness
- ✓ Quadriceps atrophy
- ✓ Valgus knee collapse
- ✓ Varus alignment
- ✓ Increased post-op graft laxity
  - ✓ increased laxity early rehab phase
  - ✓ 5-8 weeks post-operative
- ✓ Revision ACL

	Ultimate Load to Failure	Stiffness
Native ACL	2160 N	242 N/mm
Native PCL	2667 N	
Patellar Tendon Graft	2977 N	455 N/mm
Quadrupled STG	4090 N	776 N/mm
Quad Tendon Graft	2174 N	463 N/mm
Achilles Tendon Graft	4617 N	685 N/mm



### The Best Treatment Strategies

### Beynnon, Johnson, Naud, et al: AJSM '11

- PRCT Accelerated (n=24) vs Nonaccelerated (n=18) ACL rehab
- Assessed at 3,6,12 & 24 mos post-op
  - ✓ Accelerated group – greater thigh strength
  - ✓ No difference in laxity between groups  
Accel grp(3.2 mm) vs NonAccel (4.5 mm)
  - ✓ Majority of increase in laxity occurred during healing when exercises were advanced & activity level increased

Beynon, Johnson, Naud, et al: AJSM '11

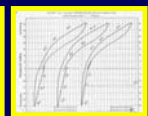
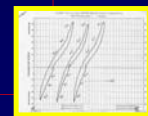
TABLE 2  
Biomechanical Measurements of the Degree of Flexion Laxity Data of the  
Translational Joint for Patients Enrolled in the Accelerated and Nonaccelerated Rehabilitation Programs\*

	Immediately After Surgery (Range)	3 Mo. After Surgery	6 Mo. After Surgery	12 Mo. After Surgery	24 Mo. After Surgery	Change Over 24 Mo. Post Surgery (95% CI - Range)
<b>Accelerated rehabilitation</b>						
A-P displacement, mm						
Mean	0.0	0.0	0.0	0.0	0.0	0.0
SD	0.0	0.0	0.0	0.0	0.0	0.0
M-L displacement, mm						
Mean	0.0	0.0	0.0	0.0	0.0	0.0
SD	0.0	0.0	0.0	0.0	0.0	0.0
Flexion displacement, mm						
Mean	0.7	0.5	0.5	0.6	0.6	0.0
SD	0.7	0.6	0.6	0.7	0.7	0.0
External rotation, deg						
Mean	0.7	0.7	0.7	0.7	0.7	0.0
SD	0.9	0.9	0.9	0.9	0.9	0.0
Internal rotation, deg						
Mean	0.7	0.7	0.7	0.7	0.7	0.0
SD	0.7	0.7	0.7	0.7	0.7	0.0
Extension rotation, deg						
Mean	0.7	0.7	0.7	0.7	0.7	0.0
SD	0.7	0.7	0.7	0.7	0.7	0.0
<b>Nonaccelerated rehabilitation</b>						
A-P displacement, mm						
Mean	0.0	0.0	0.0	0.0	0.0	0.0
SD	0.0	0.0	0.0	0.0	0.0	0.0
M-L displacement, mm						
Mean	0.0	0.0	0.0	0.0	0.0	0.0
SD	0.0	0.0	0.0	0.0	0.0	0.0
Flexion displacement, mm						
Mean	0.7	0.7	0.7	0.7	0.7	0.0
SD	0.7	0.7	0.7	0.7	0.7	0.0
External rotation, deg						
Mean	0.7	0.7	0.7	0.7	0.7	0.0
SD	0.9	0.9	0.9	0.9	0.9	0.0
Internal rotation, deg						
Mean	0.7	0.7	0.7	0.7	0.7	0.0
SD	0.9	0.9	0.9	0.9	0.9	0.0
Extension rotation, deg						
Mean	0.7	0.7	0.7	0.7	0.7	0.0
SD	0.9	0.9	0.9	0.9	0.9	0.0

Following ACL Reconstruction  
Increasing Laxity

Treatment Options:

- ✓
- ✓
- ✓
- ✓
- ✓



Following ACL Reconstruction  
Increasing Laxity

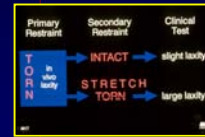
Treatment Options:

- ✓ slow the patient down
- ✓ no activities – increase ACL strain
- ✓ emphasize dynamic stabilization
- ✓ no running, heavy resistance
- ✓ ACL brace
- ✓ no extreme motion stretches



Complications Post ACL Recon  
Discussions Points

- ✓ Knee stiffness
- ✓ Quadriceps atrophy
- ✓ Valgus knee collapse
  - ✓ Knee injury mechanism
- ✓ Varus alignment
- ✓ Increased post-op graft laxity
- ✓ Revision ACL



The Best Treatment Strategies

Following ACL Reconstruction  
Revision ACL Reconstruction

Treatment Options:

- ✓
- ✓
- ✓
- ✓
- ✓



Ultimate Load to Failure & Stiffness of ACL Grafts

Graft Type	Ultimate Load to Failure (N)	Stiffness (N/mm)
Native ACL	2160 N	242 N/mm
Native PCL	2807 N	297 N/mm
Patellar Tendon Graft	2977 N	455 N/mm
Quadrupled STG	4090 N	776 N/mm
Quad Tendon Graft	2174 N	403 N/mm
Achilles Tendon Graft	4617 N	685 N/mm

Following ACL Reconstruction  
Revision ACL Reconstruction

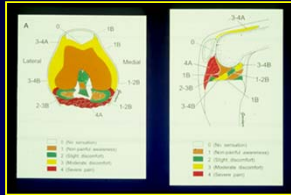
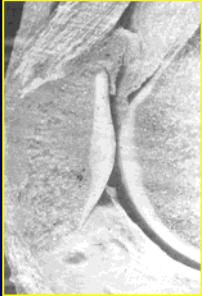
- Treatment Options:
  - ✓ find **Rx the Cause !!** for failure
  - ✓ slower rehab progress
  - ✓ emphasize dynamic stab
  - ✓ ACL brace
  - ✓ slower return to sports
  - ✓ Long term knee function



Ultimate Load to Failure & Stiffness of ACL Grafts

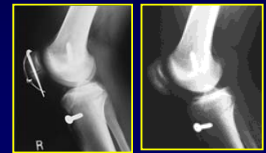
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## Painful Patellofemoral Joint



## Patellar Fracture Following ACL/PTG Specific Patients

- 19 yr old college basketball player
- 7 months following ACL/PTG
- Stress fracture developed 7 weeks prior
- Progression to complete Fx (1/95)



## Patellar Fracture Following ACL/PTG Specific Patients

- 29 yr old professional football kicker
- 10 ½ months following ACL/PTG
- Reconstructive surgery on kicking leg
- No previous history of pain prior to Fx

## Patellar Fracture Following ACL/PTG Surgical Treatment

- Transverse fracture
- Open procedure
- Patellar retinacular
- Anatomic reduction
- Internal fixation using tension band wiring



1/95

6/95

8/98



11/00

3/01

6/01



