

Proaxis Therapy ACLR Protocol Update



January 20, 2012



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

Objectives

- ▶ Understand essential components of Phase I of ACL rehab specifically quad activation and full extension
- ▶ Establish objective criteria for progression from Phase I



Ultimate Goals

Give each athlete the opportunity to be successful



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

What's the big deal?

- ▶ Returning to sport
 - 33% attempted sport at pre-injury level at one year after ACLR

(Ardern 2010)

- 64% returned to prior level of sports at 5 years after ACLR

(Lee 2008)



What's the big deal?

- ▶ Athletes with prior ACL injury are at increased risk of future ACL injury
 - 6–25% re-injury rate *(Paterno 2010)*
 - 15% who RTP within 7 months suffered re-tear *(Laboute 2010)*
 - Risk increases in younger athletes with allograft *(Kaeding 2011)*



Multi-factorial Risk

- ▶ Surgical influences
 - ▶ Rehab influences
 - ▶ Athlete influences
-
- ▶ Let's focus on rehab and preventing a less-than-desired outcome



Overview of Timelines and Focus

- ▶ Phase I (0–6 weeks)
 - Motion and mobility
 - Minimize pain/swelling to activate quad
- ▶ Phase II (7–14 weeks)
 - Muscular endurance
- ▶ Phase III (14–20 weeks)
 - Strength and functional control/absorption
- ▶ Phase IV (20+ weeks)
 - Return to participation progression
 - Full clearance (6 months)



When is the ideal time for the Sport Test?

Phase I	Phase II	Phase III	Phase IV
0-6 weeks	6-14 weeks	14-20 weeks	20 + weeks
Motion Protection Full extension	Endurance	Strength/Power	Return to Sport Progression



Overview of Timelines

- ▶ Therapy is an accordion
 - Patient and surgery-specific
 - Concomitant procedures
 - Accelerated timelines
 - If criteria are met and science allows
- ▶ Create matched expectations with the patient
 - Value of written plan/criteria



Phase I – 0–6 weeks post op

▶ Goals

- Improve motion, especially extension
- Activate the quad
- Minimize/eliminate pain and swelling
- Allow tissue healing/protect reconstruction

▶ Public Enemy #1

- Swelling
- Lack of extension
- Poor quad activation



Phase I Keys

- ▶ CREATE AN ENVIRONMENT FOR SUCCESS
- ▶ ATTENTION TO DETAIL



Criteria to progress to Phase II

“Normal” Knee

1. Full extension, near normal flexion
2. Straight leg raise with no lag – 3 sets x 30 reps
3. Mid-patellar girth < 1 cm difference
4. Normal patellar mobility
5. No heat on joint
6. Symmetrical gait
7. Minimal pain (< 2/10)
8. Single leg balance x 60 seconds on firm surface



Criteria to progress to Phase II

“Normal” Knee

1. Full extension, near normal flexion
2. Straight leg raise with no lag – 3 sets x 30 reps
3. Mid-patellar girth < 1 cm difference
4. Normal patellar mobility
5. No heat on joint
6. Symmetrical gait
7. Minimal pain (< 2/10)
8. Single leg balance x 60 seconds on firm surface



The pre-operative ACL-injured knee

- ▶ Pre-operative **extension** deficit predicts post-op extension deficit at 6 months

(McHugh 1998, Mauro 2008)

- ▶ Pre-operative **strength** deficit predicts post-op strength deficit at 2 years

(Eitzen 2008, de Jong 2007)

- ▶ Pre-operative **synovitis** correlates to post-op arthrofibrosis

(Mayr 2004)



Preoperative Indicators of Motion Loss and Weakness Following Anterior Cruciate Ligament Reconstruction

Malachy P. McHugh, MA¹

Timothy F. Tyler, MS, PT, ATC²

Gilbert W. Gleim, PhD³

Stephen J. Nicholas, MD⁴

Preoperative	Postoperative Pts $\geq 5^\circ$ Loss	Postoperative Pts $\geq 10^\circ$ Loss
Group 1: Full extension (N = 42)	N = 3 (7%)	N = 0
Group 2: 1–4° loss (N = 20)	N = 8 (40%)*	N = 0
Group 3: $\geq 5^\circ$ loss (N = 40)	N = 13 (33%)*	N = 2 (5%)



Motion Loss Exists after ACLR

- ▶ 25% had $> 5^\circ$ loss at 4 weeks post-op
(Mauro 2008)
- ▶ 12% have $> 5^\circ$ loss at 2-year follow-up
(Kocher 2002)
- ▶ 10–14% have $> 3^\circ$ deficit at 7 years post-op
(Roe 2005)



Loss of Extension is Persistent

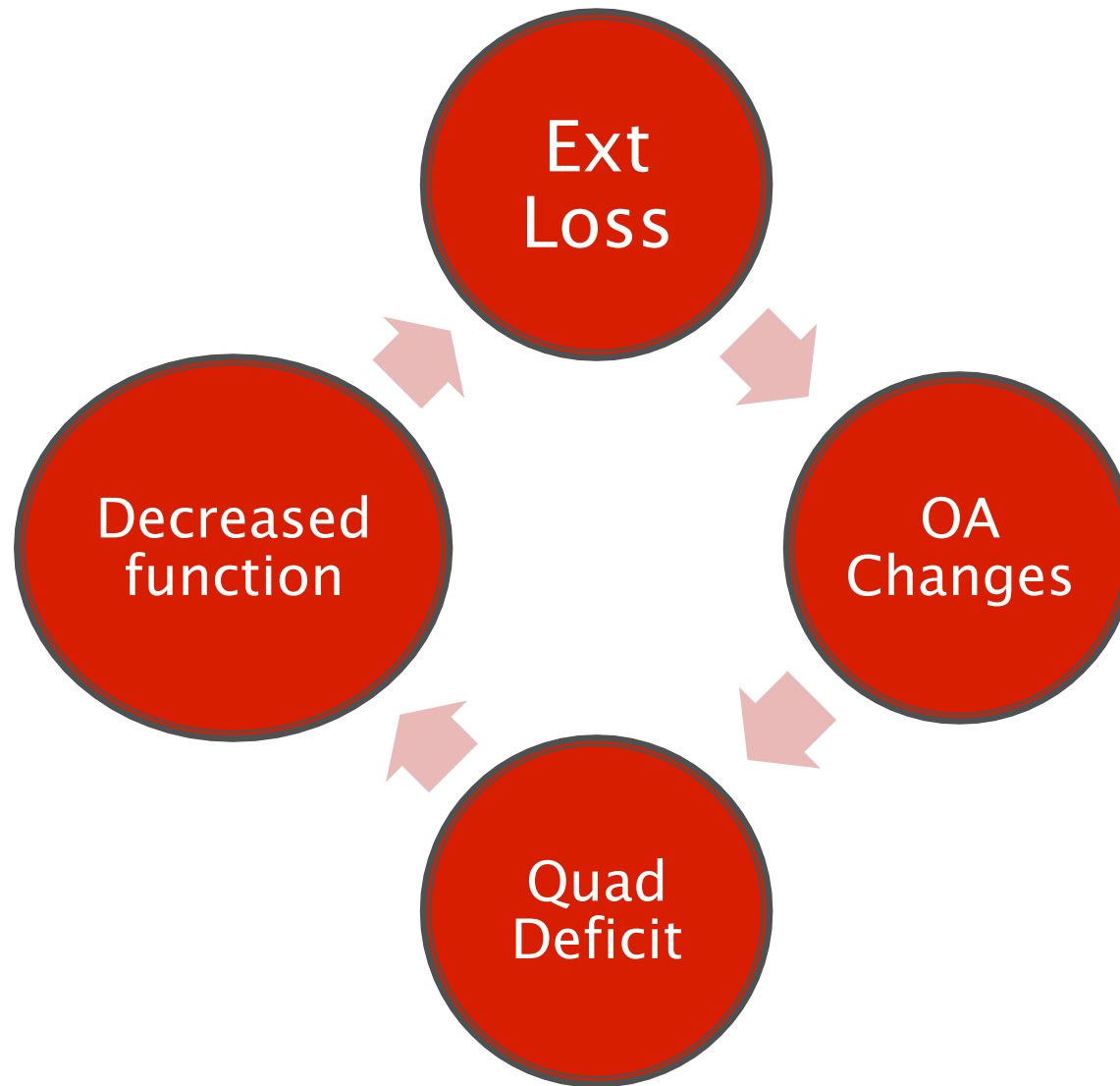
- ▶ Extension loss at 4 weeks post-op predicts extension loss at 12 weeks post-op
(Garrison unpublished 2011)
- ▶ Extension loss did not change between 2-year and 10-year follow-up
(Shelbourne 2009)
- ▶ 48% of patients with extension loss at 4 weeks required arthroscopy to achieve normal extension
(Mauro 2008)



Extension Deficits Matter

- ▶ 71% of patients with an extension deficit $> 2^\circ$ or flexion deficit $> 5^\circ$ had less than normal x-rays
(Shelbourne 2009)
- ▶ Quad strength is decreased if motion is less than normal
(Shelbourne 2009)
- ▶ Patient satisfaction decreased in patients with $> 5^\circ$ extension deficit
(Kocher 2002)





- ▶ “performing an ACL reconstruction without also obtaining full knee range of motion might cause a worse result than doing no reconstruction at all” – Shelbourne AJSM 2009



Treatment Strategies to Gain Extension

- ▶ An ounce of prevention is worth a ton of cure
- ▶ Early and often
 - Patient education
 - Begin supervised physical therapy day one
 - Home program with specific parameters



Mauro 2008

Manual Therapy

- ▶ Mobilization improves ROM and decreases pain after ACL reconstruction

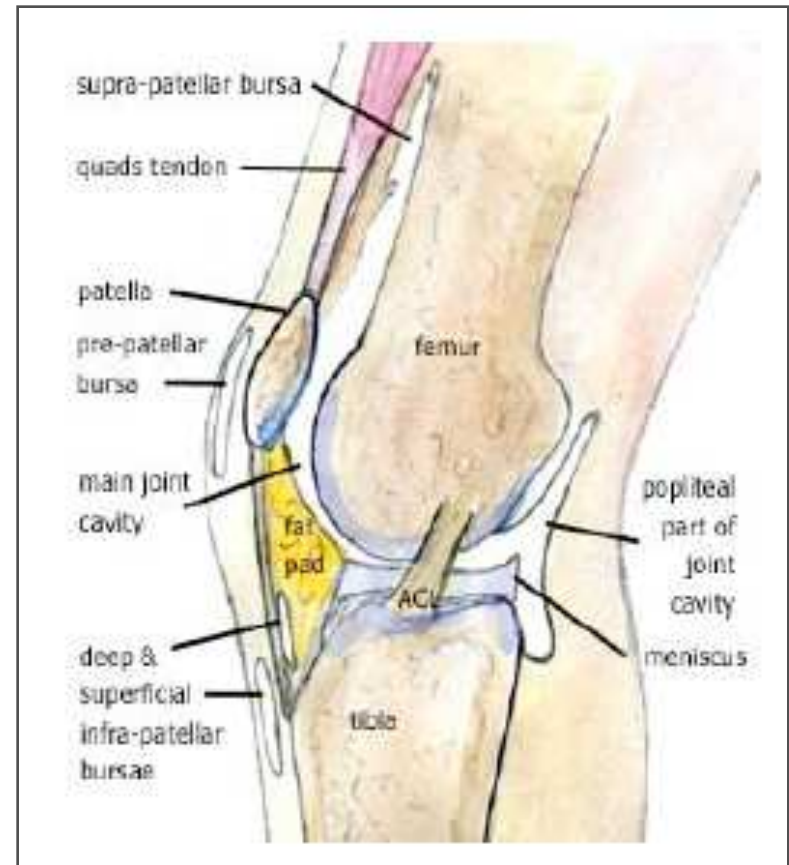
(Noel 2000)

- ▶ Mobilization decreases knee pain and stiffness, improves function

(Deyle 2000)



Patellar and Tendon Mobilization



Effects of Patellar Tendon Adhesion to the Anterior Tibia on Knee Mechanics*

S. Daniel
Richard Ste

SPORTS M

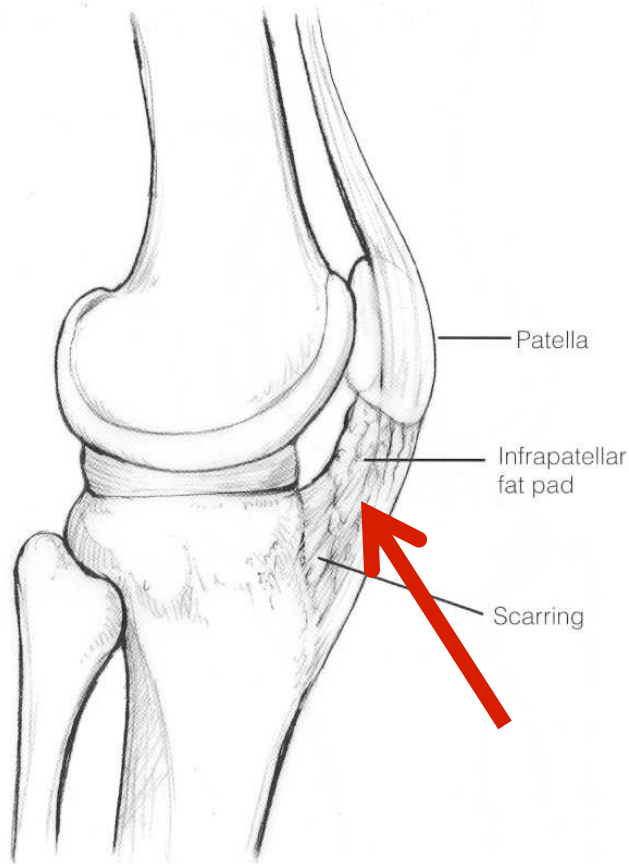


Figure 12.7 Illustration showing scarring of the infrapatellar fat pad, which results in reduced volume in the knee.

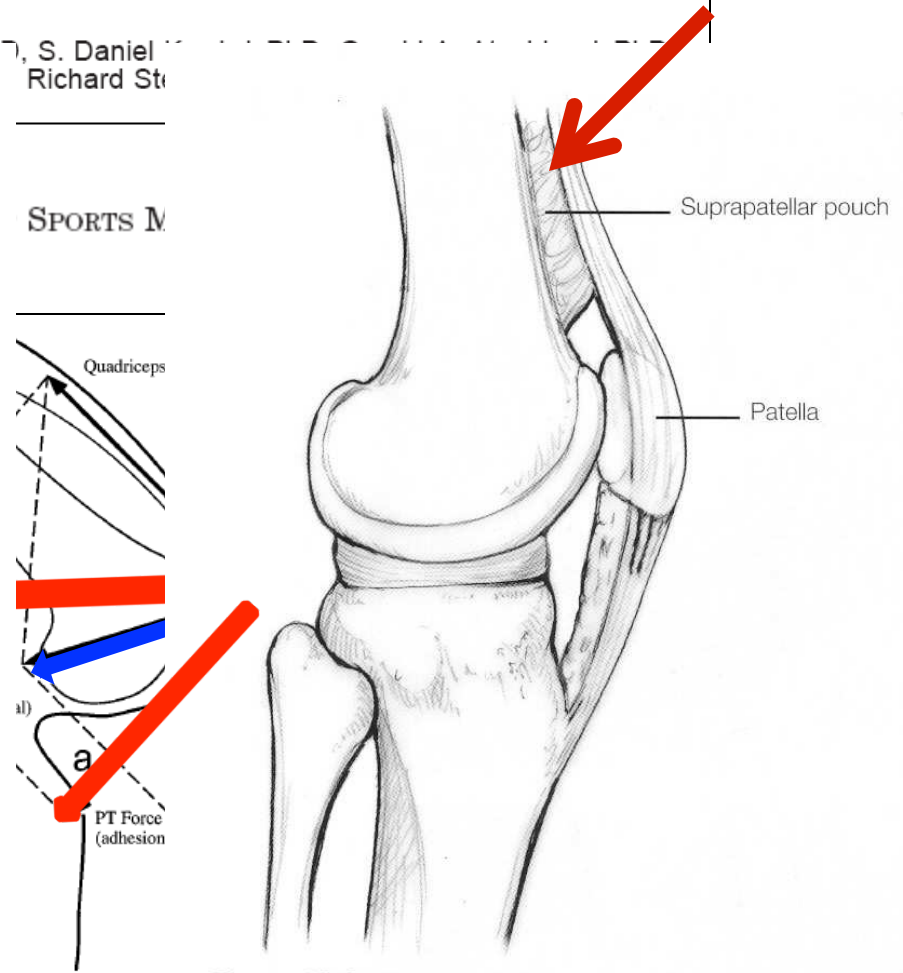


Figure 12.9 Scarring of the suprapatellar pouch compartmentalizes the space, which reduces the volume of the knee.

What about the brace?

- ▶ Several prospective studies show post-op bracing may not be necessary
(Kartus 1997, Moller 2001, Risberg 1999)
- ▶ But...none of these studies have focused on extension ROM



What about the brace?

- ▶ Melegati et al 2003
 - Post-op brace locked 0°–90°
 - Post-op brace locked at 0° for first week, then 0°–90°

- Group with brace locked at 0° had significantly more extension ROM at 4 weeks and 8 weeks post-op



Is locked at 0° enough?

**Can a post-operative brace
in slight hyperextension prevent
extension deficit after anterior cruciate
ligament reconstruction?**

A prospective randomised study

C. Mikkelsen
G. Cerulli
M. Lorenzini
G. Bergstrand
S. Werner

Knee Surg Sports Traumatol Arthrosc
(2003) 11: 318–321

Brace	Mean	Range
0°	+2.8°	+1.5° to +4°
-5°	-2.5°	+1.5° to -7°
-10°	-4.1°	-0.5° to -9°



Is locked at 0° enough?

- ▶ Mikkelsen et al 2003
 - 44 patients BTB ACLR
 - Brace at 0° or -5° for at least 3 weeks post-op
- ▶ 12-week follow-up
 - Group locked at -5°, 9% had ext loss of $\geq 2^\circ$
 - Group locked at 0°, 54% had ext loss of $\geq 2^\circ$



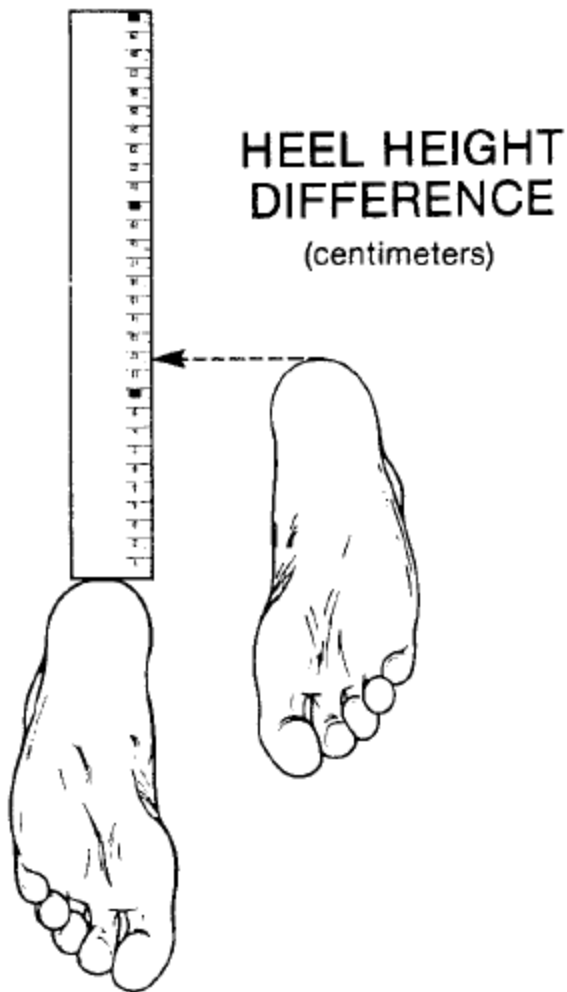
Brace or no brace, I should stop at 0° right?

- ▶ 1993 IKDC criteria
 - Calculated extension loss relative to anatomic 0°
- ▶ 2000 IKDC criteria
 - Compared to opposite knee including hyperextension
- ▶ Therefore, a patient at 0° may still have a loss of extension
- ▶ Average HS athlete has 5°–6° of hyperextension
(DeCarlo 1997)



Reliability of Heel-Height Measurement for Documenting Knee Extension Deficits*

Theodore F. Schlegel,†‡ MD, Martin Boublik,† MD, Richard J. Hawkins,†§ MD, and J. Richard Steadman,†§ MD



1 cm diff corresponds to 1.2°



proaxistherapy

DON'T JUST RECOVER. CONQUER.

KNEE EXTENSION MATTERS!



Symmetric extension



Extension lag

ONCE FULL PASSIVE EXTENSION IS ACHIEVED,
THE QUAD MUST BE ACTIVATED IN FULL
EXTENSION



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

Attack the Quad

- ▶ Activation is the key, not strength
- ▶ Emphasize activation at terminal knee extension



Attack the Quad



Terminal Knee Extension



What is good quad function?

GOOD

- ▶ Full knee extension
- ▶ No extension lag
- ▶ Controlled throughout



BAD

- ▶ Lacks full extension
- ▶ Lag
- ▶ Poor control



Plan Your Therapy Session

▶ Intentional Exercise Order

- Patellar complex mobilization with heel prop
- Manual extension
- Activate the quad in new ROM
- Terminal knee extension progression
- Then bike, flexion ROM
- Finish session with passive extension stretch such as prone hang/heel prop/calf stretch



Quadricep Function

- ▶ Arthrogenic muscle inhibition present after trauma to knee

(Palmieri-Smith 2008, Hart 2010)

- ▶ Inhibition caused by intra-articular effusion

(Torry 2000)

- ▶ Inhibition begins with as little as 10mL effusion

(Rice 2010)

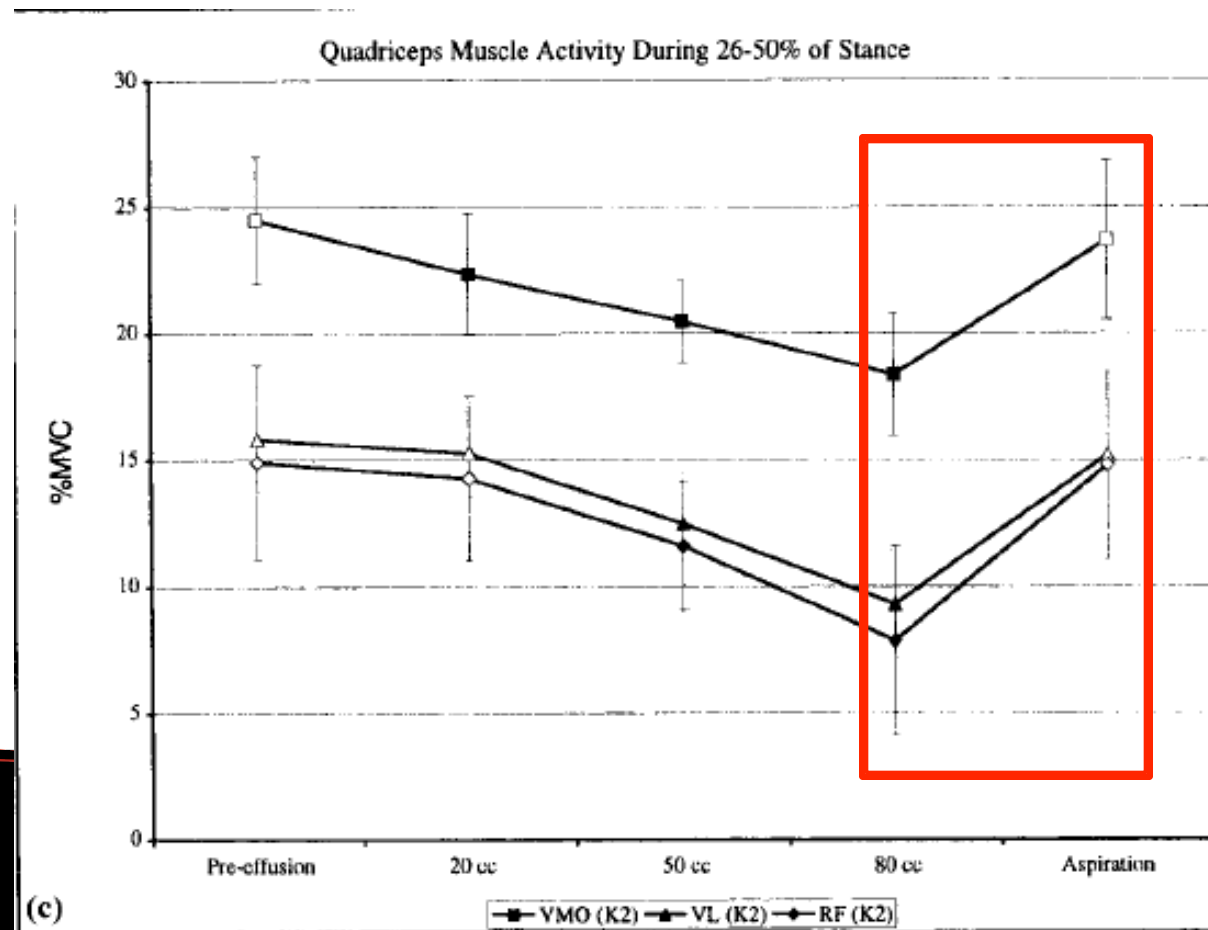


Clinical Biomechanics Award 1999

Intra-articular knee joint effusion induces quadriceps avoidance gait patterns¹

Michael R. Torry^{a,*}, Michael J. Decker^a, Randall W. Viola^b, Dennis D. O'Connor^a,
J. Richard Steadman^b

Clinical Biomechanics 15 (2000) 147–159



- ▶ Cryotherapy and TENS have been shown to disinhibit quad after effusion

(Hopkins 2001, Rice 2009)

- ▶ Biofeedback and cueing expedite return of quad function

(Draper 1990)

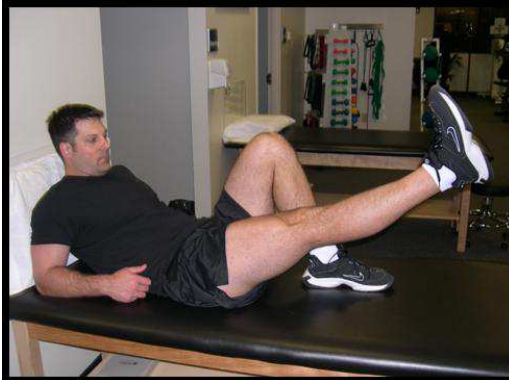
- ▶ Superimposed NMES superior to no e-stim after ACLR *(Feil 2011)*



Phase I



Quad Set



Straight Leg Raise



Patella and
Tendon
Mobilization



Wall Slides



Calf Stretching for
Extension

How early is too early?



Consider:

1. Phase I goals
2. Bone bruise/Articular cartilage injury
3. Strength goals



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

The case initiating joint loading exercise (CKC) too early

- ▶ Doesn't marry our goals very well
- ▶ Stimulus for inflammation, swelling
- ▶ Stimulus for scarring
- ▶ Risk of stiffness and motion loss
- ▶ Long term goals are strength; not short-term
- ▶ Condition of articular cartilage/bone bruise
- ▶ **Are we creating an environment for success?**



Prevalence of bone bruises with ACL tear

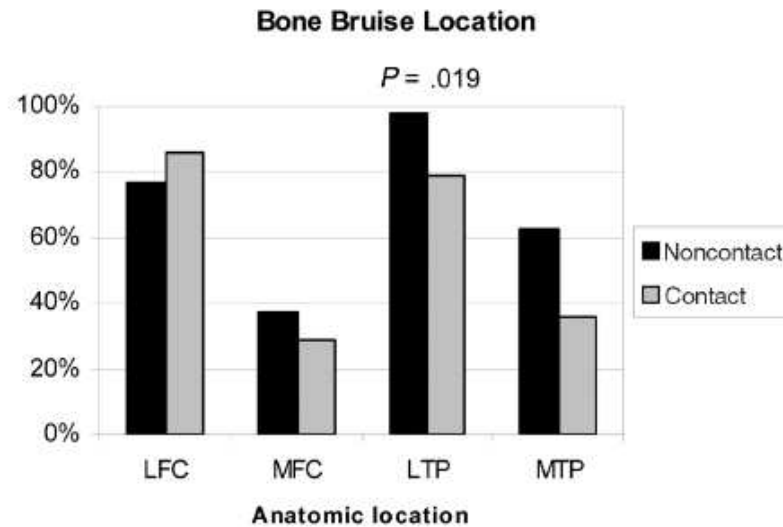


Figure 4. Pooled prevalence of bone bruising at each anatomical location in the knee. The only significant difference between the contact and noncontact groups was at the lateral tibial plateau.

(Viskontas AJSM 2008, Speer AJSM 1992)

Articular cartilage injury with ACL tear

TABLE 1. *Studies Reporting Prevalence of Articular Cartilage Injury in Acute ACL Tears*

Study	Study Type	No. of Patients	Acuity	Prevalence
Indelicato and Bittar ¹⁶ (1985)	Retrospective case series	44	<6 wk since injury	23%
Engebretsen et al. ¹ (1993)	Case series	18	“Acute rupture”	46%
Spindler et al. ⁴ (1993)	Prospective case series	54	<3 mo since injury	28%
Drongowski et al. ¹⁵ (1994)	Retrospective case series	83	“Acute”	29%
Joseph et al. ⁸ (2008)	Retrospective case series	350	<3 mo since injury	16%

Brophy Arthroscopy 2010



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

Strength Goals

- ▶ Strength gains are focus of Phase II–III
 - Strength and hypertrophy gains made in 4–6 weeks
(McArdle et al 1995)
 - Return to sport clearance at 6 months
 - Are the first 3–4 weeks too early to load the joint?
 - Aggressive progressions anecdotal cause of anterior knee pain at 3–4 months



I. Phase I: Immediate Post-Operative Phase

POD 1

- A. Brace – EZ wrap brace at zero degrees extension immediate post-op.
- B. Weight Bearing – Two crutches as tolerated (less 50%)
- C. Exercises
 1. Ankle pumps
 2. Passive knee extension to zero
 3. Straight leg raises
 4. Quad sets, glut sets
 5. Hamstring Stretch
- D. Muscle Stimulation – muscles stimulation to quads (4 hours per day) during quad sets
- E. CPM – Zero to 90 degrees as tolerated
- F. Ice and Evaluation – Ice 20 minutes out of every hour and elevate with knee in extension.

POD 2 to 4

- A. Brace – EZ wrap brace locked at zero degrees extension
- B. Weight bearing – Two crutches as tolerated
- C. Range of Motion – Patient out of brace 4-5 times daily to perform self ROM
- D. Exercises
 1. Multi-angle isometrics at 90, 60, 30 degrees (for quads)
 2. Intermittent ROM exercises continued
 3. Patellar mobilization
 4. Ankle pumps
 5. Straight leg raises (all 4 directions)
 6. Standing weight shifts and mini squats (0-30 ROM)
 7. Hamstring curls
 8. Continue quad sets/glut sets
- E. Muscle Stimulation – Electrical muscle stimulation to quads (6 hours per day) during quad sets, multi-angle isometrics and SLR's
- F. CPM zero-90 degrees
- G. Ice and evaluation – ice 20 minutes out of every hour and elevate with knee in extension.



Criteria to progress to Phase II

“Normal” Knee

1. Full extension, near normal flexion
2. Straight leg raise with no lag – 3 sets x 30 reps
3. Mid-patellar girth < 1 cm difference
4. Normal patellar mobility
5. No heat on joint
6. Symmetrical gait
7. Minimal pain (< 2/10)
8. Single leg balance x 60 seconds on firm surface



Non-Negotiable Key to Success

- ▶ Collaboration of the team
 - Athlete
 - Physician, Physical Therapist, Athletic Trainer
 - Parent, Coach



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

Quad Deficits Exist after ACLR

- ▶ Quad deficits of 12–40% present at 6 months post-op
- ▶ Quad deficits of 5–27% present at one year post-op

(Palmieri-Smith 2008)



Effects of Patellar Tendon Adhesion to the Anterior Tibia on Knee Mechanics*

S. Daniel
Richard Ste

SPORTS M

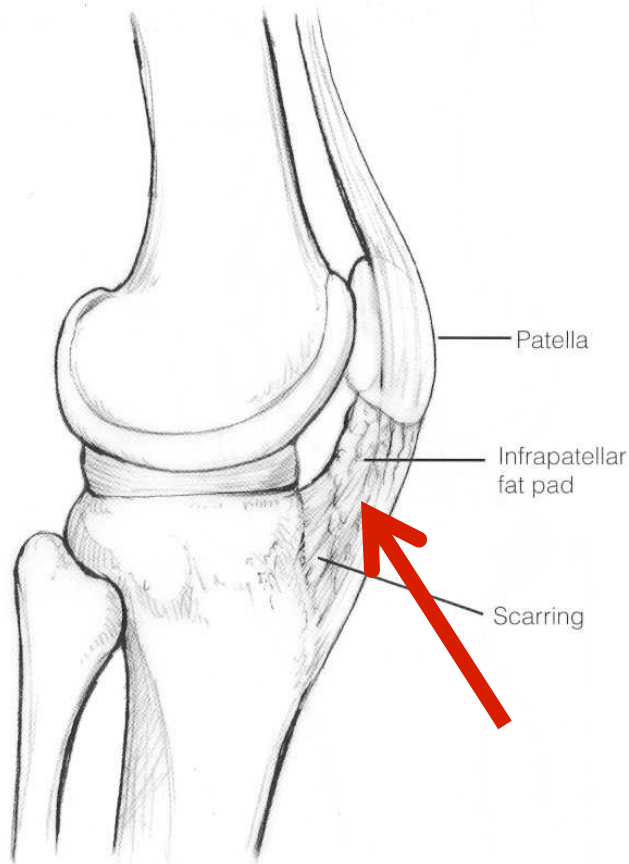


Figure 12.7 Illustration showing scarring of the infrapatellar fat pad, which results in reduced volume in the knee.

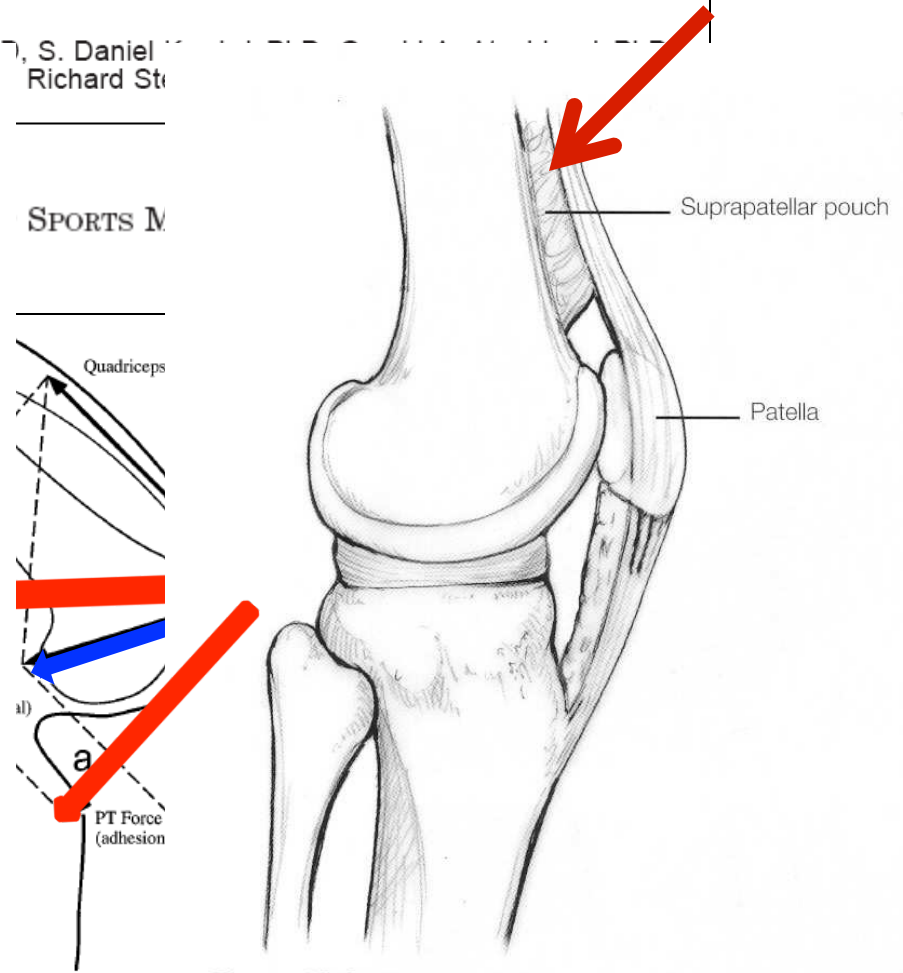


Figure 12.9 Scarring of the suprapatellar pouch compartmentalizes the space, which reduces the volume of the knee.

ROM

- ▶ Early joint motion after ACLR leads to:
 - Pain reduction
 - Less scar formation, joint contracture
 - ↓ adverse articular cartilage changes
 - Earlier and greater ROM restoration than traditional delayed programs

(Beynnon, 2005; Shaw, 2002)



Calf Stretching



Heel Slides



Quadriceps Function

- ▶ Isometric quad strengthening significantly improves restoration of ROM and knee stability

(Shaw, 2005)

- ▶ Inadequate quad strength results in altered gait pattern after ACLR

(Lewek, 2002)

- ▶ Quad deficits common and often seen bilaterally

(Hart, 2010)



Considerations for Weightbearing

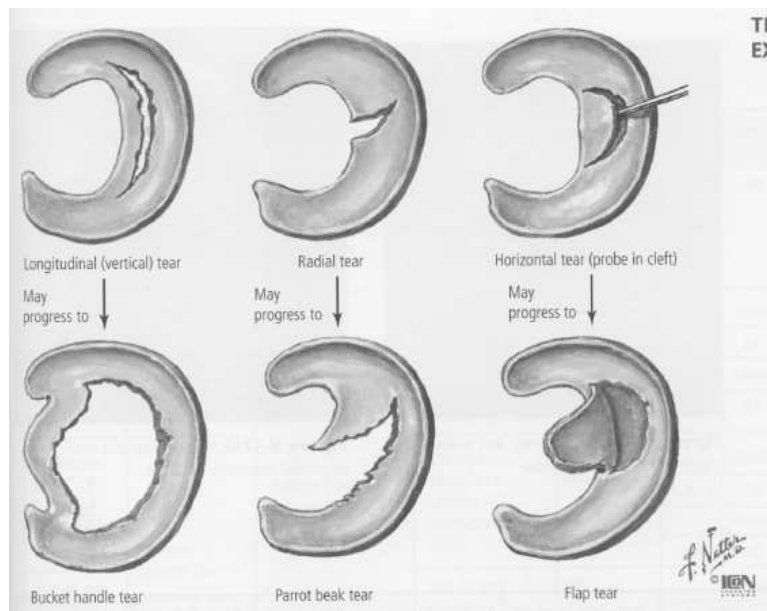
- ▶ Isolated ACLR
 - Early WBing (*Tyler, 1998*)
- ▶ Bone bruise (16–80%)
 - ↑ effusion, ↑ days to normal gait/ROM, ↑ pain scores at 4 weeks after injury

(Brophy 2010; Beynnon, 2005; Fang, 2001; Johnson, 2000)

- ▶ Matched crutch & brace progression



Potential for Development of OA



- ▶ Type of meniscus tear
 - Lateral in acute ACL
 - Radial tear
 - Medial in chronic ACL
 - Peripheral longitudinal tear
 - “ACL is the “watchdog” of the medial meniscus”
(MacIntosh)
 - Peripheral posterior horns are most common in acute and chronic

*Cerabona et al. 1998;
Thompson & Fu 1993;
Fowler & Regan 1987;
Woods & Chapman 1984*



Potential for Development of OA

- ▶ OA more common in the knee than any other joint
 - Progressive focal degradation of articular cartilage
 - Clinical manifestations
 - Pain
 - Stiffness
 - Crepitation
 - Loss of motion



Articular cartilage injury with ACL tear

TABLE 1. *Studies Reporting Prevalence of Articular Cartilage Injury in Acute ACL Tears*

Study	Study Type	No. of Patients	Acuity	Prevalence
Indelicato and Bittar ¹⁶ (1985)	Retrospective case series	44	<6 wk since injury	23%
Engelbrechtsen et al. ¹ (1993)	Case series	18	“Acute rupture”	46%
Spindler et al. ⁴ (1993)	Prospective case series	54	<3 mo since injury	28%
Drongowski et al. ¹⁵ (1994)	Retrospective case series	83	“Acute”	29%
Joseph et al. ⁸ (2008)	Retrospective case series	350	<3 mo since injury	16%

Brophy et al, 2010

Normalize Gait



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

Moving on....

...let's talk about PHASE 4!



proaxistherapy™

DON'T JUST RECOVER. CONQUER.



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

Sport Cord Test

- ▶ Developed by Howard Head Sports Medicine in CO and Proaxis Therapy in SC
- ▶ **A Functional Test**
 - 3 minutes – Single leg squat
 - 90 seconds – Lateral agility with Sport Cord
 - 2 minutes – Forward jog with Sport Cord
 - 2 minutes – Backward jog with Sport Cord
- ▶ **NEW** objective scoring for each component
 - Must score 46/54 to pass

(Wahoff et al 2011; Garrison et al 2011; Beecher et al 2010; Saltzer et al 2000)



Sport Cord Test



proaxistherapy™

(2010; Stalzer et al 2000)

DON'T JUST RECOVER. CONQUER.

Passing the Sport Cord Test

- ▶ Allows an **advanced agility & controlled play** progression to begin
- ▶ Passing sport cord test **should not equal** immediate, unrestricted participation
- ▶ Must be combined with **sport-specific** and position-specific demands



Sport Cord Test

▶ *Be on the lookout for....*

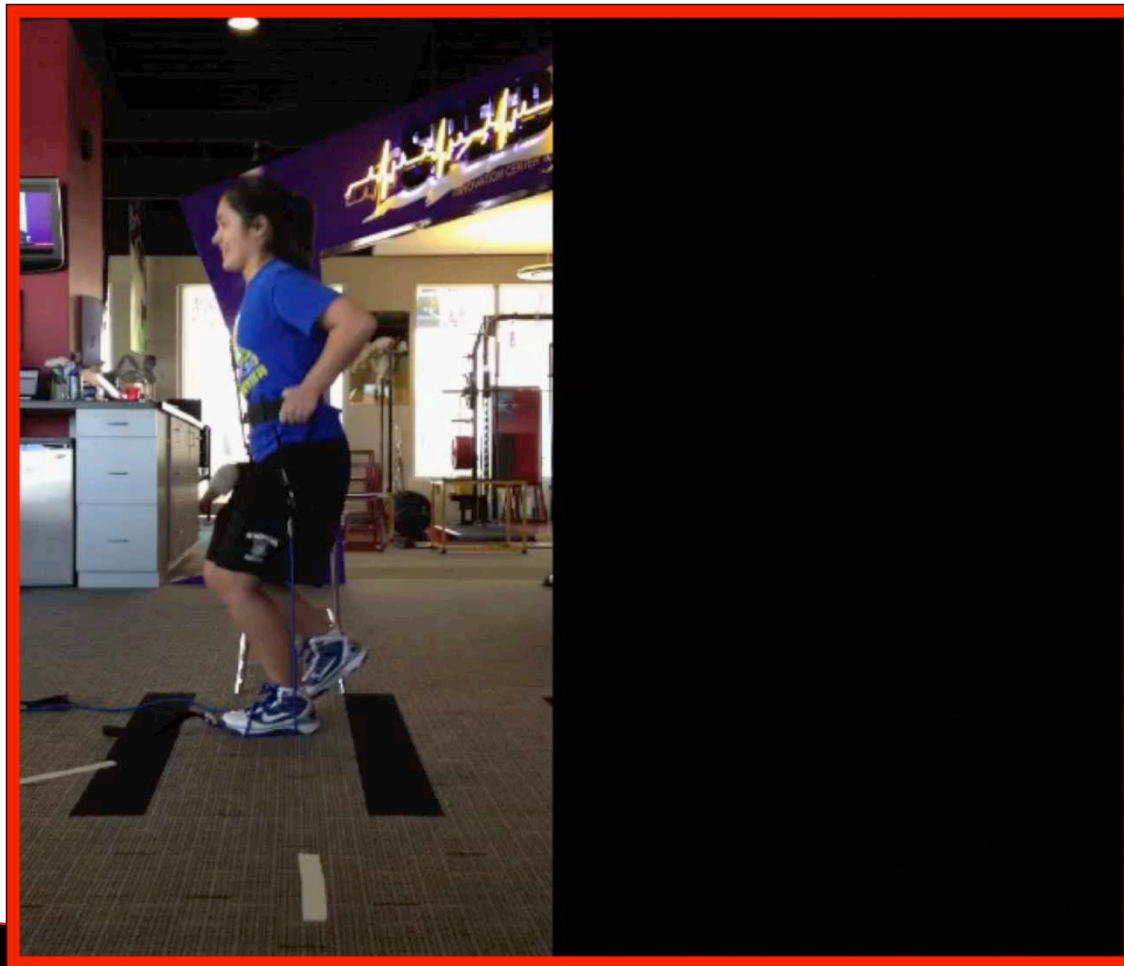
- Fatigue
- Posting
- Asymmetry
- Hip drop
- Trunk:
 - lateral flexion
 - contralateral shoulder flexion



Control & Endurance



Knee excursion



proaxistherapy™

DON'T JUST RECOVER. CONQUER.



CONSIDER SYMMETRY



proaxistherapy™

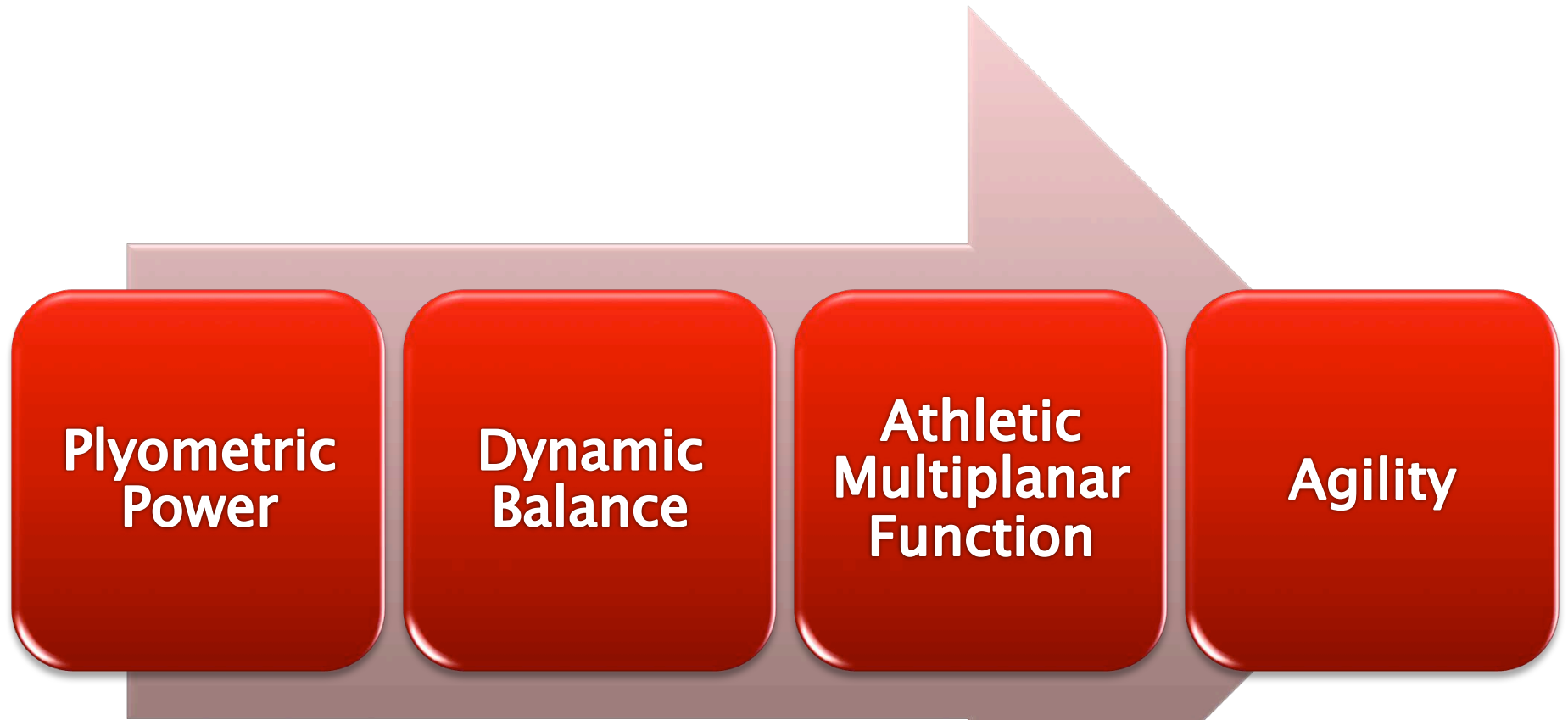
DON'T JUST RECOVER. CONQUER.

Criteria for Progression to Phase 4

- ▶ Sport cord Test $\geq 46/54$
- ▶ Symmetric running gait
 - *Audibly rhythmic foot strike without gross asymmetries in visual kinematics when running between 6–10 mph*
- ▶ Y-Balance Test: anterior reach within 4cm of uninvolved limb



Phase 4 Goals



Participation

Play



Phase 4 Keys

- ✦ Controlled, predictable → Unpredictable
- ✦ Individual drills → Team Drills
- ✦ Non-contact → Contact

- ✓ Supervised rehab ~1 x/wk for 4–6 wks
(individualized program)
- ✓ Coordination with ATC



High Risk Movement Patterns: What to look for?



ACL Load–Deformation & Injury Factors

- ▶ ↓ Knee flexion
- ▶ ↑ “Apparent” knee valgus
- ▶ ↑ Tibial rotation (toe-in / toe-out)
- ▶ ↓ Trunk flexion
- ▶ ↑ Trunk lateral flexion
- ▶ ↓ Joint angular displacement (stiff)
- ▶ Asymmetrical foot contact (single leg)

Courtesy of Darin Padua PhD, ATC



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

Criteria for Return to Play

- ▶ Hand-held dynamometry within 90% of uninvolved limb
 - knee extensors
 - knee flexors
 - hip abductors
- ▶ Single hop for distance within 90% of uninvolved limb
- ▶ LESS \leq 5
- ▶ Y-Balance Test: 94% composite when fatigued



Hand-held dynamometer



Hip Abduction



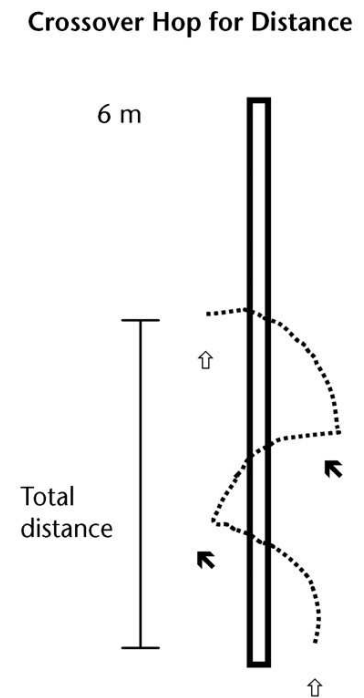
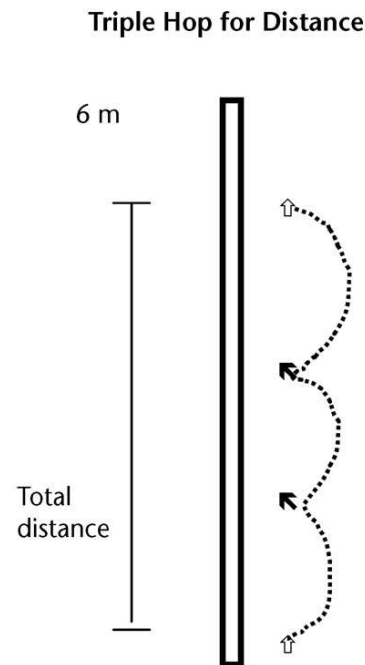
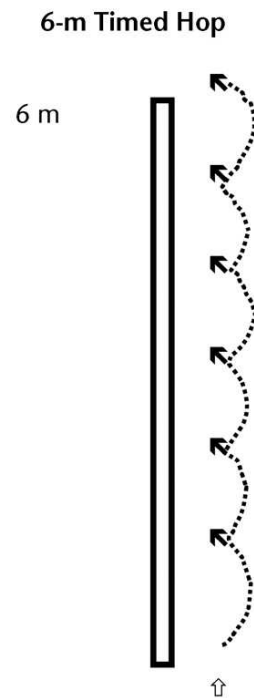
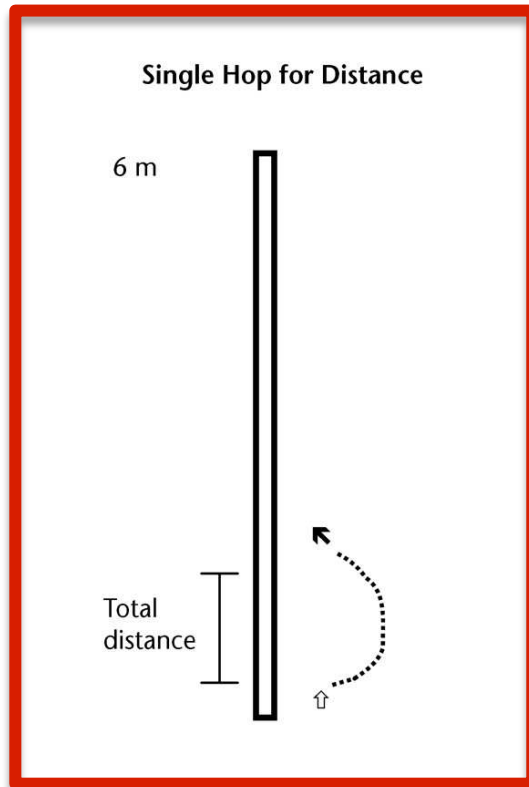
Knee Flexion



Knee Extension



Diagrammatic representation of the series of 4 hop tests: single hop for distance, 6-m timed hop, triple hop for distance, and crossover hop for distance.



Reid A et al. PHYS THER 2007;87:337-349

Physical Therapy
Journal of the American Physical Therapy Association

Factors Influencing Re-Injury



- ▶ Gender
 - Males = Females (*Shelbourne et al, 2009*)
- ▶ Timing of Return to Play (RTP)
 - RTP < 6 mos = > 6 mos (*Shelbourne et al, 2009*)
 - ↑RIR with RTP < 7 mos + high demand activity (*Laboute et al, 2010*)
- ▶ Sport Type / Physical Activity Level
 - ↑RIR in high demand activity (pivoting, cutting, landing, jumping) (*Laboute et al, 2010; Shelbourne et al, 2009*)
 - ↑RIR in basketball (52%) (*Shelbourne, 2009*)
 - Soccer (15%) and other sports (6.6%)

Slide Courtesy of Darin Padua PhD, ATC

Landing Error Scoring System (LESS)

▶ WHAT

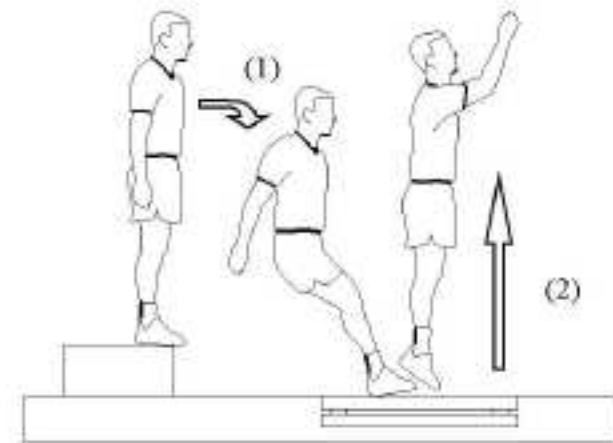
- Functional test evaluating **jump-landing mechanics**
- Identify risky movement patterns

▶ WHEN

- Phase 4, RTS clearance

▶ GOAL

- LESS \leq 5



JUMP ACL
MONITORING AND PREVENTING ACL INJURIES



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

What does the LESS tell us?

- ▶ Quality of movement matters
- ▶ ACLR movement \neq Healthy movement

People move differently following ACLR



Causation or compensation?



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

LESS...how?

- ▶ Drop height: **30 centimeter box**
- ▶ Horizontal distance = **50% body height**
- ▶ Jump for **maximal vertical height** immediately after landing
- ▶ Do not provide feedback or coaching on landing technique unless task is performed incorrectly
- ▶ After task instruction, allow subject to perform practice trials until the task is successfully performed



LESS

- ▶ A successful jump is characterized by:
 - Jumping off of **both** feet from the box
 - Jumping forward, but **not vertically** to reach the ground
 - Completing the task in a fluid motion
- ▶ **Video Analysis**
 - Record 3 trials (using 2 cameras)
 - Grade videos on 17 items
- ▶ **Live Analysis**
 - Grade on 10-item score sheet



LESS



	LESS Item	Operational Definition	Camera View	Error Condition	LESS Score
1	Knee flexion angle at initial contact	At the time point of initial contact, if the knee of the test leg is flexed more than 30 degrees, score YES. If the knee is not flexed more than 30 degrees, score NO.	Side	No	Y=0 N=1
2	Hip flexion angle at initial contact	At the time point of initial contact, if the thigh of the test leg is in line with the trunk then the hips are not flexed and score NO. If the thigh of the test leg is flexed on the trunk, score YES.	Side	No	Y=0 N=1
3	Trunk flexion angle at initial contact	At the time point of initial contact, if the trunk is vertical or extended on the hips, score NO. If the trunk is flexed on the hips, score YES.	Side	No	Y=0 N=1
4	Ankle plantar-flexion angle at initial contact	If the foot of the test leg lands toe to heel, score YES. If the foot of the test leg lands heel to toe or with a flat foot, score NO.	Side	No	Y=0 N=1
5	Knee valgus angle at initial contact	At the time point of initial contact, draw a line straight down from the center of the patella. If the line goes through the midfoot, score NO. If the line is medial to the midfoot, score YES.	Front	Yes	Y=1 N=0
6	Lateral trunk flexion angle at initial contact	At the time point of initial contact, if the midline of the trunk is flexed to the left or the right side of the body, score YES. If the trunk is not flexed to the left or right side of the body, score NO.	Front	Yes	Y=1 N=0
7	Stance width – Wide	Once the entire foot is in contact with the ground, draw a line down from the tip of the shoulders. If the line on the side of the test leg is inside the foot of the test leg then greater than shoulder width (wide), score YES. If the test foot is internally or externally rotated, grade the stance width based on heel placement.	Front	Yes	Y=1 N=0

8	Stance width – Narrow	Once the entire foot is in contact with the ground, draw a line down from the tip of the shoulders. If the line on the side of the test leg is outside of the foot then score less than shoulder width (narrow), score YES. If the test foot is internally or externally rotated, grade the stance width based on heel placement.	Front	Yes	Y=1 N=0
9	Foot position - Toe In	If the foot of the test leg is internally more than 30 degrees between the time period of initial contact and max knee flexion, then score YES. If the foot is not internally rotated more than 30 degrees between the time period of initial contact to max knee flexion, score NO.	Front	Yes	Y=1 N=0
10	Foot position - Toe Out	If the foot of the test leg is externally rotated more than 30 degrees between the time period of initial contact and max knee flexion, then score YES. If the foot is not externally rotated more than 30 degrees between the time period of initial contact to max knee flexion, score NO.	Front	Yes	Y=1 N=0
11	Symmetric initial foot contact	If one foot lands before the other or if one foot lands heel to toe and the other lands toe to heel, score NO. If the feet land symmetrically, score YES.	Front	No	Y=0 N=1
12	Knee flexion displacement	If the knee of the test leg flexes more than 45 degrees from initial contact to max knee flexion, score YES. If the knee of the test leg does not flex more than 45 degrees, score NO.	Side	No	Y=0 N=1
13	Hip flexion at max knee flexion	If the thigh of the test leg flexes more on the trunk from initial contact to max knee flexion angle, score YES.	Side	No	Y=0 N=1
14	Trunk flexion at max knee flexion	If the trunk flexes more from the point of initial contact to max knee flexion, score YES. If the trunk does not flex more, score NO.	Side	No	Y=0 N=1

15	Knee valgus displacement	At the point of max knee valgus on the test leg, draw a line straight down from the center of the patella. If the line runs through the great toe or is medial to the great toe, score YES. If the line is lateral to the great toe, score NO.	Front	Yes	Y=1 N=0
16	Joint displacement	Watch the sagittal plane motion at the hips and knees from initial contact to max knee flexion angle. If the subject goes through large displacement of the trunk, hips, and knees then score SOFT. If the subject goes through some trunk, hip, and knee displacement but not a large amount, then AVERAGE. If the subject goes through very little, if any trunk, hip, and knee displacement, then STIFF.	Side	Average or Stiff (double penalty for Stiff)	Soft=0 Av.=1 Stiff=2
17	Overall impression	Score EXCELLENT if the subject displays a soft landing and no frontal plane motion at the knee, Score POOR if the subject displays a stiff landing and large frontal plane motion at the knee. All other landings, score AVERAGE.	Side, Front	Average or Poor (double penalty for Poor)	Ex.=0 Av.=1 Poor=2



LESS

▶ *LESS Real-Time*

- Perform 4 trials
- Grade real-time on 10 items
 - **T1**: Frontal (Items 1–3) – Stance width, foot rotation, and initial foot contact
 - **T2**: Frontal (Items 4–5) – Knee and trunk frontal-plane motion
 - **T3**: Sagittal (Items 6–7) – Foot position when landing and knee sagittal-plane motion
 - **T4**: Sagittal (Item 8) – Trunk sagittal-plane motion



Frontal-Plane Motion

1. Stance width

- Normal (0)
- Wide (1)
- Narrow (1)

2. Maximum foot-rotation position

- Normal (0)
- Externally rotated (1)
- Internally rotated (1)

3. Initial foot contact

- Symmetric (0)
- Not symmetric (1)

4. Maximum knee-valgus angle

- None (0)
- Small (1)
- Large (2)

5. Amount of lateral trunk flexion

- None (0)
- Small to moderate (1)

Sagittal-Plane Motion

6. Initial landing of feet

- Toe to heel (0)
- Heel to toe (1)
- Flat (1)

7. Amount of knee-flexion displacement

- Large (0)
- Average (1)
- Small (2)

8. Amount of trunk-flexion displacement

- Large (0)
- Average (1)
- Small (2)

9. Total joint displacement in the sagittal plane

- Soft (0)
- Average (1)
- Stiff (2)

10. Overall impression

- Excellent (0)
- Average (1)
- Poor (2)





Knee Flexion



Knee Valgus



Hip/Trunk Flexion



Lat. Trunk Flexion



Narrow Stance



Wide Stance



Toe In



Toe Out

LESS – incorrect



proaxistherapy™

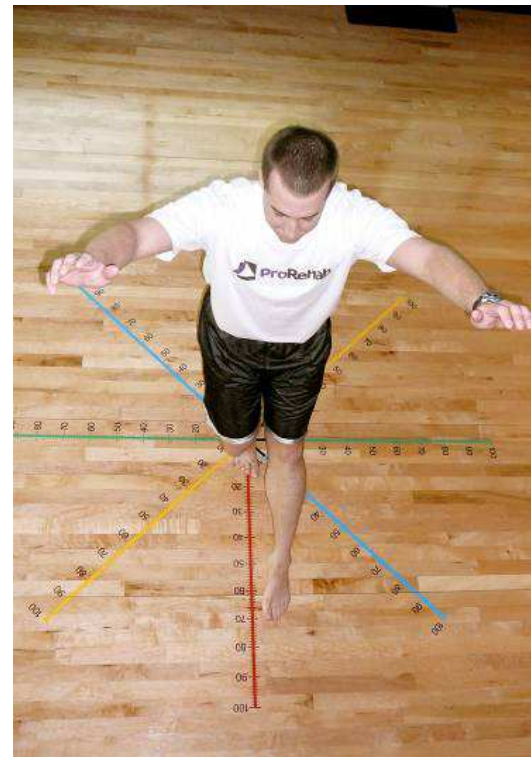
DON'T JUST RECOVER. CONQUER.

LESS – correct



Star Excursion Balance Test (Y-BALANCE)

- ▶ First described by Gary Gray 1995
- ▶ Detects functional performance deficits associated with LE pathology
- ▶ Series of LE reaching tasks that challenge postural control, strength, proprioception and ROM



Star Excursion Balance Test

- ▶ Has been used to identify Chronic Ankle Instability (CAI)
 - 2.5–4 cm side to side difference
 - Altered neuromuscular control at knee at hip
 - Fatigue amplified side to side difference

Olmstead 2002, Gribble 2004



Practicality

- ▶ Pre-participation Physicals
- ▶ Injury Prevention Screens
- ▶ Pre/Post Measures for Functional Rehabilitation
- ▶ Multi-sport Application
- ▶ **Return to Sport Testing**



Y-Balance Test



- Reliable and predictive of lower extremity injury risk:
2-6x increase in injury risk if unsuccessful in test.

(Plisky, Rauh, Kaminski, Underwood, JOSPT 2006)



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

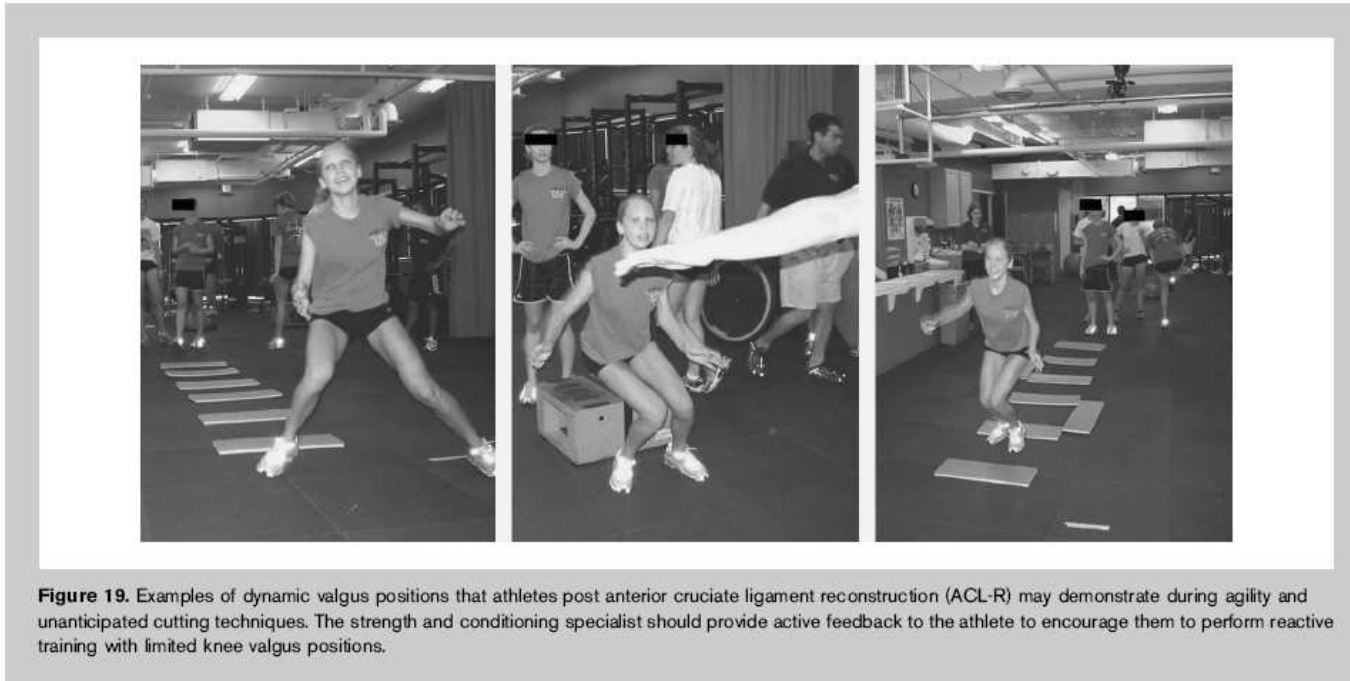
Phase 4: test when fatigued



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

Unpredictable environment still needed



Myer et al, 2008

An athlete must meet all demands of his/her sport before stepping on the field



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

Sport Specific Training



Agility Drills



Unpredictable Cutting Drills

Myer et al, 2008



Turning Right

Cloverleaf Drill

Turning Left

3-Cone Drill



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

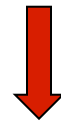
Criteria for Return to Play

- ▶ Hand-held dynamometry within 90% of uninvolved limb
 - knee extensors
 - knee flexors
 - hip abductors
- ▶ Single hop for distance within 90% of uninvolved limb
- ▶ LESS \leq 5
- ▶ Y-Balance Test: 94% composite when fatigued

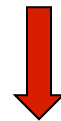


Ideal Athlete RTP Flow

MD – Medical Clearance



PT – Functional Clearance/ Return to Participation



ATC – Competition Clearance/Return to Play

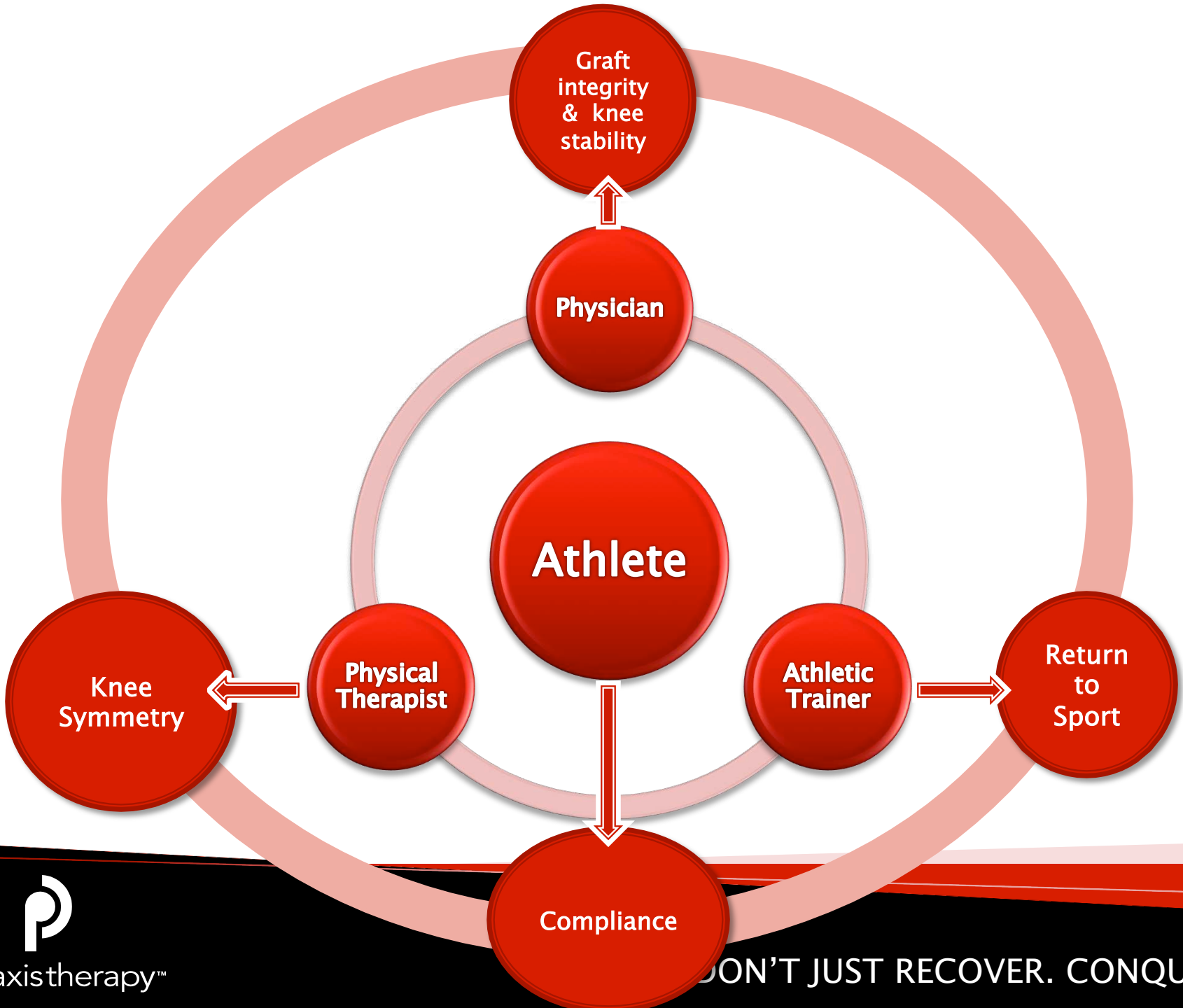


Influences



- ▶ Parents
- ▶ Coaches
- ▶ Timing
 - In-season (early/mid/late), playoffs, off-season
- ▶ Position
- ▶ Athlete's goals
 - Senior yr, college...





Remember....our ultimate goals

Return athlete to sport
Decrease risk of subsequent ACL injury



proaxistherapy™

DON'T JUST RECOVER. CONQUER.

Example of timeline

- ▶ Surgery: January 20
 - ▶ Sport Cord Test: June 20
 - ▶ Return to participation: July 20
 - ▶ Full return to sport: August 20
-
- ▶ 7 months: surgery → sport
 - risk?
 - too soon?
 - how to reintegrate?



THANK YOU! QUESTIONS?



proaxistherapy™

DON'T JUST RECOVER. CONQUER.