ACL Surgery and Rehabilitation: Pearls for the new PT
Presented by:
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About me
- Facility Manager McFarland Somerset clinic
- Accelerated Rehab Sports Medicine Manager
- Worked for Accelerated for 12 years
- Went to ISU and Iowa
- Worked for the Portland Trailblazers for 2 seasons
- Originally from Waverly
- Predominate clientele sports and orthopedics

You cannot rehab an ACL patient unless you fully understand the ACL and the ACL surgery
The Anterior Cruciate Ligament

- One of the four structural ligaments of the knee
  - Primary (85%) restraint to anterior translation of the tibia on the femur
  - Rotational stability

ACL injuries are becoming common

- Incidence of ACL injury in the US currently at 200,000 annually with 100,000 having reconstruction (Miyaska)
- Occurs primarily in those individuals participating in high risk sports such as basketball, football, skiing and soccer
- Eight times more prevalent in females vs. males (Wojtys)
Mechanism of Injury

- Most common MOI is deceleration coupled with cutting, pivoting or sidestepping maneuvers, awkward landings or “out of control” play (Griffin, Kerkendall, and Colby)
- Estimated 70% of ACL injuries occur through non-contact mechanisms and 30% via direct contact (Griffin)
- Hyper-extension, rotation and posterior valgus force

Increased Risk for females

- According to Beynnon et al American Journal of Sports Medicine 2005:
  - Soccer (youth 3x, collegiate 2.3-4x)
  - Basketball (high school 3x, collegiate 4x)
  - Skiing (high school 3x)

Why is it more common in females?

- Differences in strength and conditioning
- Poor flexion angle with landing on jumps
- Neuromuscular control
- Q angle
- Valgus lower leg alignment
- Increased ligamentous laxity
- Hormones
- Menstrual cycles
Genetic link to ACL ruptures in females

- A study performed by Posthumus and published in the American Journal of Sports Medicine November 2009 showed that the COL5A1 gene was underrepresented in females with ACL injuries.
- First ever study performed that showed a specific genetic risk factor associated with risk of ACL tears in female athletes.

Examination

- Patient history
- X ray
- Special tests
- MRI
**Patient History**

- Very important in determining ACL injury
  - Mechanism of injury
  - Effusion
  - Reports feeling a “pop” and knee is unstable
  - Difficult to bear weight
  - Pain with full extension and lack of full flexion

**Special tests**

- Lachman’s
- Anterior Drawer test
- Pivot Shift

**Lachman’s test for ACL instability**

- Place knee in 20-30 degrees of flexion
- Stabilize the femur with one hand and place opposite hand under the proximal tibia
- Pull tibia anteriorly
- Soft, mushy end feel positive for ACL injury
Lachman’s vs. Pivot Shift or Anterior Drawer
- Easier for patient to relax (false negative)
- Hamstrings provide more restraint to anterior displacement the closer the knee gets to 90 degrees of flexion
- The knee is considerably more painful with an acute injury the closer the knee gets to 90 degrees of flexion

What are your options if you tear the ACL?
- Surgery
- No surgery

Non surgical intervention
- Aggressive rehabilitation to increase strength and proprioception
- Bracing optional
**Indications for non surgical intervention**

- Partial tear with no instability symptoms
- Complete tear with no symptoms of instability during low impact sports/activities and patient is willing to give up high demand sports
- People who do light manual work or who are sedentary
- Growth plates are open (children)

**Does non surgical intervention work?**

- If patients are sedentary or do no high impact sports or activities - YES

**Risks of not doing surgery**

- Secondary damage can occur in patients who have repeated episodes of knee instability
- In a ten year study performed by Andersson researchers followed patients who chose not to do surgery, 90% had meniscus damage and 70% had articular cartilage lesions
Surgical options
- Patella tendon autograft (bone tendon bone)
- Hamstring autograft (semitendinosus, gracilis, both)
- Quad tendon autograft
- Allograft

Surgical risks
- Osteoarthritis
- Numbness is scar area (superficial peroneal and lateral cutaneous nerves cut)
- Infection
- Blood clots
- Anesthesia

Open vs Scope
- No Differences in Prevalence of Osteoarthritis or Function After Open Versus Endoscopic Technique for Anterior Cruciate Ligament Reconstruction: 12-Year Follow-up Report of a Randomized Controlled Trial (American Journal of Sports Medicine-Sept 13 2012) (Holm, Oiestad, Risberg, Gunderson, Aune)
Patients treated with one of the surgical options had a long term success rate of 82-95% (Andersson)

Goals of any ACL reconstruction
- Prevent instability and potential secondary damage
- Restore function

Bone Patella Bone (BTB)
- Gold standard
- High load to failure rate
- Superior fixation
- Durable
Downside to BPB graft

- Post op knee stiffness
- Post op patella femoral pain
- Pain with kneeling
- Risk of patella fracture

Hamstring Graft

- Outer third of the semitendinosus tendon and the gracilis tendon are bundled together to become the new ACL
- Graft is put through an Endo button for fixation into the femoral tunnel
- Benefits include less anterior knee pain, increased motion, smaller incision, faster recovery due to less anterior knee pain

Hamstring graft vs. BTB

- Pinczewski in the American Journal of Sports Medicine April 2007 showed that at 10 years post op there was no statistical difference between the hamstring and BTB rupture rates
- Complaints of anterior knee pain and pain with kneeling were significantly higher in the BTB group
- Radiographic osteoarthritis was statistically more common in the BTB group
- Hamstring strength and tensile strength of the harvest site return to within 95% of pre surgical values
If it doesn’t hurt as much, doesn’t cause as much long term damage, and it lasts just as long, why not use the hamstring graft?

Quad tendon
- Most commonly used for revisions of previous ACL surgeries due to its large tensile strength
- Bone plug only on one end
- High risk for anterior knee pain

Allograft (cadaver)
- Patella tendon
- Achilles tendon
- Semitendinosus
- Gracilis
- Posterior tibialis tendon
Allograft risks

- Rejection
- Infection
- Susceptible to stretching (Sun)
- Study reports a 23-34.4% failure rate vs. 5-10% for any autograft (Sun)

JOSPT June 2011

- Athletes who did not score at least 90% when compared bilaterally on the Three Hop Test were 44% more likely to re rupture their ACL within one year post op
- Three Hop Test: single hop, cross over hop and triple hop

When can you return to sports?

- No pain or swelling
- Full ROM
- Full strength and endurance
- Full neuromuscular and proprioceptive abilities
- Pass all functional testing (LE hop test)
- Usually occurs around 6 months post op
Chmielewski reported asymmetrical lower extremity loading can lead to both an increase risk of retearing and increased risk of OA.

Reduced loading decreases chondrocyte activity and synthesis thereby changing the composition of the articular cartilage and making it structurally inferior.

Myer et al came out with a research report that stated bipedal and modified double limb test results would routinely show that a person was strong enough to return to sports, however once single limb testing was performed significant deficits were shown.

Three Hop Test showed the best sensitivity to find deficits between limbs.

What two factors most positively influence the outcome of an ACL surgery and rehab?

- Compliance to home exercise program
- AGGRESSIVE REHABILITATION!!
What is an ACCELERATED rehab protocol?

- After reading numerous articles, it is pretty much agreed upon that any ACL protocol that gets the patient on their feet before two weeks post op is considered an accelerated rehab.
- In the 1980’s (DeCarlo), patients were in a cast for 6 weeks non weight bearing. Full motion took 4 months, return to sport 12 months.
- Found patients who were non-compliant were actually doing better!

Why is early weight bearing important?

- Wolff's Law (Wikipedia): Bone and soft tissue are deposited and resorbed in accordance to the stresses placed upon it.
- Early weight bearing PROMOTES HEALING.
- Goal of any protocol is to decrease postoperative complications and return the knee to normal function as soon as possible.

How well your ACL rehab goes is directly dependent upon how well you educate your patient at the FIRST visit.
First visit
- Explain the surgery
- Discuss frequency and duration
- Stress the importance of the home program
- Reassure the patient that weight bearing is OK

Post op Day 1
- Remove all dressings except Steri strips
- Review icing protocol—Important
- Motion and girth measurements
- Weight shifts and quad exs
- PROM and estim (if needed)

Example of Day 1 exercises
- Quad sets 2 x 10
- Heel slides 2 x 10
- Standing weight shifts
- Standing hamstring curls
- Calf raises
How to Stretch Day 1

- Your patient is more than likely sore and SCARED TO DEATH!!
- Sit them up at the side of the table
- Put your knee under their foot
- Light soft tissue massage
- Gentle ROM
- The better control you have of their leg the better they will RELAX

Day 1 thru week 2

- Get rid of crutches as soon as safely possible
- Brace stays locked into extension for two weeks except in the clinic
- Proprioceptive exs (DD, ½ FR, BOSU, etc.)
  - Start with balance, progress to balance squats
- Easy hamstring exs
- Limit squats to 30 degrees of flexion (CKC minimal to no stress to ACL. Flemming- Am Journal of SM '05)
- Aquatic therapy once wound is healed
- Goal of 90 degrees flexion

Exercise examples

- Double leg squats first
  - Back straight and limit flexion to 30 degrees
  - Cue them on knees over their feet
  - Feet shoulder width apart
  - Don’t let them lean- establish good mechanics early!
  - Increase frequency or length of hold to make it harder, NOT depth of bend
Balance exercises

- Half foam roll—balance then squats
- Wobble board—balance then squats
- Dyna discs—balance then squats
- BOSU ball—balance then squats
- Rebounder
- Air Ex balance

BOSU ball

- Black side up
  - Double leg balance
  - Double leg squats
- Blue side up
  - Lunges
- Black side up because you cannot maintain good knee mechanics on the blue side due to the curvature of the ball

Why is it OK to squat to 45 degrees of flexion?

- Escamilla et al found that wall squats produced the greatest amount of quadriceps force with minimal to no ACL stress if performed at 50 degrees of flexion or less.
- ACL forces were mostly produced with single leg squats, especially at 30 degrees of flexion
- Tibiofemoral and Patella femoral compressive forces were higher with narrow stance squats
- Flemming et al found minimal stress with OKC knee ext 90-60 degrees and CKC squats to 45 degrees, resulting in better quad strength at 3 and 6 month follow up.
Take home point
- Shoulder width squats from 0-50 degrees of flexion produced the greatest amount of quad activation with the least amount of stress to the TF, PF and ACL.
- Limiting depth of bend is essential to protecting the ACL and decreasing anterior knee pain.
- Remember the knee hinges and glides.
- OKC knee ext produces minimal ACL stress and PF stress 90-60 degrees.

Get your patient on their feet!!!

Weeks 2-4
- Goal of 120 degrees of flexion.
- Unlock the brace once the patient can demonstrate excellent quad control and no pain with weight bearing.
- Progress the sets, reps, and resistance/difficulty of all squat/lunge exs.
- Hamstring and RDL exs.
- 10 minute max on the bicycle.
- Risk of stretching the graft with repetitive flex/ext.
Example of Week 3 workout

- Bike 5 minutes
- Leg press 2 x 20 reps with 10 pounds
- Single leg wall curler press 2 x 20 reps
- Step ups 6 inch box 2 x 20 reps
- Step downs 4 inch box 2 x 15
- Single leg squats hold rail 2 x 15 reps
- Lunge on BOSU 2 x 20 reps
- Dyna disc squat 2 x 15 reps
- Wobble board squat 2 x 15 reps
- BOSU black side up squat 2 x 15 reps
- Swiss ball bridge 2 x 15 reps
- TB wall sit 2 x 30 feet
- Schwe ball dead lift 2 x 15 reps
- SL calf raise 2 x 20 reps
- Rebounder SL ball toss 2 x 20 throws

Weeks 5-8

- Progress towards full flexion
- Continue to progress weight bearing exs
- Single leg squats
- OK to start elliptical
- Begin jumps
- Easy agility
- Single leg hops once double leg hops and SL squats are easy and demonstrated with excellent control

Example of Week 6 workout

- Elliptical 10 minutes
- Leg press DL and SL 2 x 20
- Hamstring curl machine 3 x 15 reps
- RDL 2 x 15 reps
- SL squats with 5 pounds on BOSU 2 x 15 reps
- 6 inch step ups with 10# Dumbbells 2 x 20 reps
- 4 inch step ups/donets 2 x 15 reps
- DD squats with weight 2 x 15 reps
- DD squats with weight 2 x 20 reps
- DD SL squat with weight 2 x 15 reps
- DD SL squat with weight 2 x 20 reps
- SL BOSU squats 2 x 20 reps
- SL BOSU squats with 5 pounds on 2 x 10 reps
- Ladder agility
- DL hops side/side and forward/back 2 x 20 sec each
- DL jumps on bench 2 x 15 reps
- SL hops both the rail 2 x 20 sec
- Band assisted 3 x 1 min
When can I start jogging?

- Jogging, in its simplest form, is a series of single leg hops.
- Jogging cannot be performed until the patient is at least 8 weeks post op and can demonstrate good control and no pain with single leg hops for distance or in place.
- LE hop test 80% involved vs uninvolved.
- Surgeon dependent!

Weeks 9-12

- Jogging
- Increase jumping drills
- Progress agility drills
- Sport specific exercises
- Increase endurance
- Core exercises
- Get brace fitted if needed

Example of Week 10 workout

- CT sprints, leg extensions
- Leg press 90° x 1.25 reps
- Leg press 90° x 2.5 reps
- Leg press straight x 10 reps
- Leg press 45° x 10 reps
- PPL 90°/180° x 10 reps
- DL 45° x 20 reps
- SL squat matrix x 10 reps
- Leg curls 45° x 10 reps
- RDL's 2 x 10 reps
- DD, BOSU, WB squats with weight
- Box jumps
- SC jumps
- SL hops for distance
- Side hop
- Ladder splits
- Pecking squats
- Progressing to depth jumps
- Progressing to the board
- FR calf
- FR ham
- FR quadriceps
Discharge from PT

- Girth measurements and functional strength within 90% compared bilaterally
- Three hop test within 90% compared bilaterally
- Functional Movement Screen > 15
- Y balance test
- Functional Discharge Report
- Cannot return to sport until functional testing 100%
- “Gray area” from D/C from PT and return to sports secondary to exhausted benefits, money concerns, etc.

At the time of return to sport, individuals post-ACLR who had weaker QF (QI of less than 85%) demonstrated decreased function, whereas those with minimal QF strength deficits (QI of 90% or greater) demonstrated functional performance similar to uninjured individuals. QF strength deficits predicted hop test performance beyond the influences of graft type, presence of meniscal injury, knee pain, and knee symptoms. J Orthop Sports Phys Ther 2012;42(9):750-759, Epub 19 July 2012. doi:10.2519/jospt.2012.4194.

Keys to a successful rehab

- Review HEP weekly
- Stay engaged with the patient
- Variety
- Be positive
- Be a motivator
- Be FUNCTIONAL
Questions??

References


