ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION
Rehabilitation
Where are we in 2021?

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DISCLOSURES

EDITOR: INTERNATIONAL JOURNAL OF SPORTS PHYSICAL THERAPY
ELSEVIER SCIENCE
HUMAN KINETICS

WU SHOCK

OBJECTIVES

1) List key points for rehabilitation following ACL reconstruction
2) Describe common problems or issues that may occur following ACL reconstruction

PREVALENCE

- Approximately 100,000 ACL reconstructions are performed annually.
- Occurs to 250,000 people per year in the United States


PREVALENCE

- Disrupted more than any other ligament in the body


- 35/100,000 people per year


- 1 out of every 3000 people will suffer an ACL injury per year


ALLOGRAFT

ADVANTAGES

- Numberous graft options
- Avoidance of donor site morbidity
- Shorter rehabilitation time frames
- No other options


Disadvantages

- Risk of general bacterial infection
- Not increased in Allo vs Auto


- Gamma irradiation
- Consistently changes biomechanical and biochemical properties of allografts


ALLOGRAFT VS AUTO IN YOUNGER

- Systematic review with meta-analysis
- Comparative studies of allograft vs autograft in those <25 years of age and high activity level
- 7 studies - 788 AUTO; 288 ALLO
- Mean age 21.7 years; follow up time 24-54 months

**ALLOGRAFT VS AUTO IN YOUNGER**

- **POOLED FAILURE VARIANCE**
  - **AUTOGRFTS:** 9.6% (76/788)
  - **ALLOGRAFTS:** 25% (57/228)


**AUTO VS ALLO**

- **POOLED FAILURE RATES IN ALLOGRAFT VS AUTO IN YOUNGER POPULATION**
- **FAILURE RATES:**
  - **AUTO:** 6%
  - **NON-BRANCHED ALLO:** 9%
  - **BRANCHED ALLO:** 34%


**GRAFT MATUREITY**

- **ALL NORMAL FUNCTION BY 2 YEARS**
- **NO SUBJECTIVE SCORE DIFFERENCE**
- **NO DIFFERENCE IN LAXITY MEASURES**
- **SIGNAL/NOISE QUOTIENT: ALLOGRAFT SIGNIFICANTLY HIGHER THAN AUTOGRFT**
- **INDICATING INFERIOR GRAFT MATUREITY**


**GENERAL ACL REHABILITATION**


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**PRIMARY GOAL OF ACL RECONSTRUCTION**

- Restoration of knee stability
- Safe and expedient return to normal activities and athletics
- Early recognition of complications

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**PRE-OP PHASE**

- Preparation for surgery
- Reduce swelling and pain
- Restore motion
- Quadriceps activation and recruitment
- Controlled activities
- Mental preparation for surgery

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**CRYOTHERAPY**

- Patients utilizing continuous cryotherapy
- Required less medication
- Converted from injectable to oral meds sooner
- Greater percentage of compliant patients


Cryotherapy

- Patients utilizing continuous cryotherapy
- Were out of bed and ambulating sooner
- Performed ROM exercises with more ease.


Cryotherapy


Knee Effusion

- 53 year old male following right lateral patellar tendon rupture repair after fall.
- Used cryogenic device for 2 weeks post-op.
- Received at 4 weeks with discharge of both knees.
- Then dermabrasion, dressing change and brace coverage.


http://www.healio.com/orthopedics/journals/ORTHO/%7B8F4A824C-B066-4708-8242-3CBA7482B0F9%7D/Severe-Frostbite-of-the-Knees-After-Cryotherapy/full=1

Knee Effusion

- 4 weeks after first tissue skin graft transplant.

Lee CK, et al. Severe frostbite of knees after cryotherapy. Orthopedics. 2007;30:

http://www.healio.com/orthopedics/journals/ORTHO/%7B8F4A824C-B066-4708-8242-3CBA7482B0F9%7D/Severe-Frostbite-of-the-Knees-After-Cryotherapy/full=1
ELECTRICAL STIMULATION FOR POST OPERATIVE KNEE PAIN

- Faster recovery
- Less peripheral edema
- Greater ROM
- Less pain


MAXIMUM PROTECTION PHASE
0-6 WEEKS: GOALS

- Protect graft fixation
- Minimize effects of immobilization
- Control swelling and inflammation
- Achieve full extension ASAP
- Educate patient on rehab


BONE MINERAL DENSITY - ACL

- 6.6% < AT TROCHANTERIC REGION
- 4.0% < FOR ENTIRE HIP
- 3.4% < FOR INTERTROCHANTERIC REGION


WEIGHT BEARING

- 24 PATIENTS PER GROUP
  - CONTROLS
  - 6-12 WEEKS
  - 6-7 MONTHS
  - 12-15 MONTHS


WEIGHT BEARING

- SMITH-SQUAT RACK
- PEDAL SCAFFOLD
- 5 SETS OF 9 SQUATS - RANDOMIZED
- 3 ANGLES (30°, 60°, 90°)
- 3 WEIGHTS (40% BLM ONLY: 33% BLM, 50% BLM)


WEIGHT BEARING

- DO YOU FEEL LIKE EQUAL WEIGHT PLACED THROUGH BOTH FEET?
- SIGNIFICANT DIFFERENCES (P<0.05) BETWEEN WITHIN GROUP INTERACTION WITH WEIGHT AND ANGLE


WEIGHT BEARING

- 6-12 WEEKS
  - UNCONSCIOUS "UNLOAD"
  - 6-7 MONTHS
  - UNCONSCIOUS "UNLOAD"
  - 12-14 MONTHS
  - DO NOT "UNLOAD"


WEIGHT BEARING

- MOST PATIENTS THOUGHT THEY HAD DEMONSTRATED EQUAL WB
- T ACCELERATED REHABILITATION PROGRAM
- FULL SPORTS AT 6 MONTHS AFTER SURGERY
- BENEFIT OF EARLY SINGLE-LEG EXERCISE


STATISTICALLY SIGNIFICANT DECREASE IN ANTERIOR KNEE PAIN
- Pain in 7/20 restricted WB
- Pain in 2/25 immediate WB
- ROM and KT scores not sig different between groups


MUSCLE RECRUITMENT


98% of patients with normal motion, normal articular
cartilage and intact menisci had normal radiographs.
Even a 3-5° loss of extension motion compared to opposite
knee affected outcomes.

Shelbourne KD, Gray T. Minimum 10-year results after anterior cruciate
ligament reconstruction. How the loss of normal knee motion compounds

2 years following ACLR
MUA following reconstruction
Even after surgery (MUA) athletes still have decreased strength and decreased functional abilities


Extension immediately
Gradual return of flexion
Week 1 = 90
Week 2 = 100-120
Week 3 = 110-125
Week 4 = 125+
Week 0-6 = symmetrical to opposite side

Regain full extension ASAP
Passive end extension with ice, block, postoperative range
Total end range time = 10/7
Low Load Long Duration Stretching = LLDS
Intensity, frequency, and duration

Flowers K, Lanatos P. Effect of total end range time on improving passive

61 62 63 64 65 66
• Patellar mobility must be restored ASAP.
• Failure to restore normal mobility will result in patellar instability.
• Enables restoration of ROM and quadriceps firing.
• Prevents anterior knee pain.
• Protects patellofemoral joint from chondromalacia or OA.

MODERATE PROTECTION PHASE
6-12 WEEKS
• Normalize gait.
• Maintain full extension.
• Protect fixation.
• Full flexion ROM.
• Improve strength, endurance, and proprioception of lower extremity.

TOTAL LEG STRENGTH (TLS)
• SLR x 4.
• Multi-hip.

MINIMAL PROTECTION PHASE
12-24 WEEKS
• CKC Rom and exercise from 90° to 45° lateral.
• Advanced CKC exercises:
  • Single leg squats.
  • Leg press 0° to 45°.
  • Step-up progression.
  • Balance and proprioception.

• Genicular patellar mobilizations to decrease risk of ITBS, arthrosis, knee flexion contracture.
• Wall slides and heel slides to increase knee flexion.
Bilateral squats level ground
Progress with weighted balls or dumbbells

Advanced CKC exercises
Squats on labile surface
Watch for proper form!
Balance and proprioception

Restore dynamic balance and functional stability

Proprioception and neuromuscular control restores functional stability
Perturbation training

Advanced CKC exercises
Balance and proprioception
- Single-leg exercises important
- Athletes in competition spend tremendous amounts of time in a single-leg position
- Single-leg landing training

- Single-leg landing training
- Poor landings!
- Be careful of excessive rotation in the transverse plane upon landing.

- Single-leg landing training
- Good landings!

- Squats
- Lunge onto labile surface
- Lunge with perturbation
- Sports specific tasks

MINIMAL PROTECTION PHASE

- Emphasis placed on light functional activities such as jogging, stepping, footwork and agility drills
- These activities can be initiated if strength assessment reveals 75-80% of uninjured side and anthropometer reveals stable graft
- Plyometrics and velocity spectrum isokinetics can be begun
- By 6 months most return to full pre-injury activity level
MINIMAL PROTECTION PHASE
12-24 WEEKS

- Plyometrics and velocity spectrum isokinetics can be begun.
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RETURN TO SPORT PHASE 6-9 MONTHS

- Goals
- Progress:
  - Strength
  - Power
  - Proprioception

- Continue strengthening and flexibility as previous.
- Walk/jog progression.
- Forward/backward running.
- Cutting/crossover.
- Sports specific drills.

6 MONTHS = 23% (3-40%)

12 MONTHS = 14% (3-28%)

ACL IS AT GREATEST RISK IN INITIAL 9 MONTHS


THE 3 P’S OF RETURN TO PARTICIPATION

• P1 PERFORMANCE TRAINING
  • DRILLS IN CLINIC

• P2 PRACTICE PARTICIPATION
  • PRACTICE — LOWER TO HIGHER INTENSITIES

• P3 PLAY
  • GRADUAL INITIATION INTO GAME SITUATION


Deficits in Quad Strength

Protocols have not been shown to change graft healing and maturation times

ACL is at greatest risk in initial 9 months following surgery


Psychological impairments after ACL injury - Do we know what we are addressing? Experiences from sports physical therapists


Young athletes after ACL reconstruction with asymmetric quadriceps strength at the time of return-to-sport clearance demonstrate drop-landing asymmetries two years later.