ACL REHAB

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DISCLOSURE

I have no relevant financial or nonfinancial relationship(s) within the topics described, reviewed, evaluated or compared in this presentation.
ACL Rehab

OBJECTIVES

- Determine the significance of prehabilitation
- Identify benchmarks in a postoperative ACL protocol
- Determine phase appropriate goals during ACLR rehabilitation program
- Identify proper Progression Criteria for activity advancement
- Identify factors limiting neuromuscular control after ACL injury
QUESTIONS ???

1. Do patients have better results if they participate in formal therapy prior to ACLR?

2. Is it acceptable to progress a patient based on protocol timelines?

3. Does a patient need to achieve all the goals of the preceding phase prior to being progressed to the next phase during ACLR rehab?

4. What is best approach to regaining quadriceps strength after ACLR?
PREHAB

Prehabilitation has been defined as “the process of enhancing functional capacity of the individual to enable them to withstand the stressor of inactivity.” (1)
PREHAB

• Loss of 50% of quadriceps strength in the first 14 weeks after ACL injury of ACLR
• Biomechanical changes: decreased extensor torque at knee, increased extensor torque at hip (3,4,5,6)
• Good preoperative strength (>90%) results in higher postoperative strength at 1,3 months when compared to poor quad strength (<75%) group (2)

• Preoperative quadriceps strength: predictor of the functional outcome knee joint after ACLR (7)
PREHAB

• **Strength Training**

• A pre-rehabilitation strategy of progressive muscle strengthening prior to ACLR:
  – Improved knee function
  – Improved quadriceps peak torque at 30 degrees of flexion
  – Improved total work (8)

• 4-6 pre-rehabilitation program followed by a 4 month minimum program after ACLR:
  – Improvement in the shuttle run, side step and carioca
  – Minimal deficit between injured and uninjured leg at 6 months post-op.(9)

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Prehab

- **Proprioception and NM training**
- ACL rupture: impaired proprioception
  - increase latency of hamstring contraction
  - ongoing instability in the ACL deficient knee
  - predisposing to DJD

- Preoperative management of proprioception leads to significantly better outcomes than those undergoing the traditional exercise regime (11)

- **Prehab focus:**
  - somatosensory input from the weight distribution of the foot
  - afferent information coming from the lower extremity to enhance joint proprioception and muscle response

- **Perturbation training program versus strength training(3-4 wks.)**
  - Poor dynamic knee stability prior to initiation
  - perturbation group had better symmetrical quadriceps strength (97% of the injured leg) and gait (13)
  - Improve NM feedback, decrease antagonistic muscle activity

- The perturbation technique yields a 92% success rate compared to the standard group that had a 50% success rate (no episodes of “giving way”) at 6 months post-op. (12)
QUESTIONS??
Is it acceptable to progress patients based on protocol timelines?

Does a patient need to achieve all the goals of the preceding phase prior to advancing to the next during ACLR rehab?
ACL REHAB PROTOCOL /Physical Therapy Goals

• Pre-op goals
  – minimal pain, swelling and inflammatory response
  – full ROM and NM control

• Crutch training and independence in postsurgical exercises

• Understanding the rehab program and process:
  – increases self efficacy during rehabilitation
  – stimulates early recovery of knee function
  – decreases expected postsurgical pain
  – creates realistic view about the rehabilitation process (14-20)
ACL REHAB PROTOCOL /Physical Therapy Goals

PHASE 1 (week 1)

Most important goals:
- controlling pain, swelling and inflammation
- recovery of ROM and NM control

• Aggressive control of pain, swelling and inflammation:
  - prevents quadriceps inhibition
  - maintains full extension
  - makes immediate weight bearing possible (14,18,20,21)

• Immediate recovery of passive and active ROM
  - reduces pain
  - stimulates the homeostasis of cartilage
  - prevents patellofemoral problems, alterations in gait pattern, quadriceps atrophy and arthrofibrosis.

• Multi-directional mobilizations of patella
  • Prevent patellar immobility (leading to decreased ROM and quadriceps inhibition) (22,23)

• Regaining muscle control without endangering the graft
  - isometric
  - closed chained (0-60 is safe range)
  - open chain (90-40 is safe range) without additional weight.

** Theses exercises should include muscle setting exercises, SLR, heel slides, mini squats (0-30 flexion) body weight shifting/acceptance (14-25)
ACL REHAB PROTOCOL /Physical Therapy Goals
PHASE 2 (week 2-9)

Goals

• Walk without crutches (day 4-10)

• Normalize gait
  – Walking on a treadmill week 3
  – Jogging in a straight line week 8

• Full ROM (maintain full extension)
  – 120 degrees flexion from week 2
  – Attain and maintain good patellar mobility
ACL REHAB PROTOCOL /Physical Therapy Goals
(Phase 2 Cont’d)

Interventions

• Cryotherapy
• Flexion can be increased gradually
• Full extension and patellar mobility will be maintained.
• Isotonic strength training (in a safe range, CC 0-60, OC 90-40) aimed at endurance:
  – increases quadriceps strength significantly
  – has no negative effect on anterior knee pain and knee laxity (25)
• Quadriceps strength and hamstring strength can be increased by isometric isotonic and isokinetic exercises without endangering the graft (25)
• Inadequate extension can be treated aggressively to prevent postsurgical complications like arthrofibrosis

• Phase appropriate exercises:
  – walking on a treadmill, cycling on an ergometer and swimming from week 3,
  – stair stepping week 4
  – and jogging a straight line, outdoor cycling from week 8 (25)

• Neuromuscular training:
  – static stability
  – dynamic stability.
  • vestibular and somatosensory system for balance,
    – increase surface instability / decrease visual input.
ACL REHAB PROTOCOL /Physical Therapy Goals
(Phase 2 Cont’d)

Special Considerations

• **In phase 2 the strength of the graft is not optimal** (15, 17, 18, 19, 23)

• Predisposing factors for quadriceps weakness after 6 months
  – Quadriceps atrophy
  – Persistent quad lag with SLR
  – Incomplete extension
  – Gait impairments (26)
ACL REHAB PROTOCOL /Physical Therapy Goals
Phase 3 (Week 9-16)

Goals
• Decrease pain and swelling
• Obtain and maintain full ROM
• Increase Muscle Strength
• Regain Neuromuscular control
Special Considerations

• NM control
  – functional dynamic balance training
  – plyometric exercises

• Increase knee stability with CC and OC exercises (14,16,18,20,24,25)
  – Tensile strength of the graft is rising

• Endurance training to resistance training
  – Determined by pain and swelling
  – CC ad OC exercises for the ideal bases for sport specific function training in phase 4 (19-25)
ACL REHAB PROTOCOL /Physical Therapy Goals
Phase 3 (Week 9-16)

Special Considerations

• Functional movement patterns:
  – improve the interactions between stabilizing structures of the kinetic chain (27)

• Plyometric exercises:
  – preparation for agility training (ph 4)
  – improve the concentric contraction power of the muscle(28)
  – allows for quicker changes in direction

• Stimulate coordination and control (afferent and efferent information processing)
  – variation in visible input
  – surface stability,
  – speed of exercise performance
  – complexity of the test
  – resistance
  – single legged and two legged performance (25)

• Specific exercises for phase 3 should include normalization of running (gradually increasing duration and speed to decrease NM adaption and recovery time) from week 9 to progress to jogging outdoors week 13 (6,24,41)
ACL REHAB PROTOCOL /Physical Therapy Goals
Phase 4 (Week 16-22)

GOALS

• Maximizing endurance of ACLR leg
• Maximizing strength of the knee stabilizers
• Optimize NM control
• Regaining agility
ACL REHAB PROTOCOL /Physical Therapy Goals
Phase 4 (Week 16-22)

Intervention

- Plyometric exercises
  - Optimizing NM control
- Sports specific agility training
  - with variations in running, turning, and cutting maneuvers,
  - acceleration and decelerations,
**Improves arthrokinetic reflexes so that new trauma during competition can be prevented (21,27,29)**
Progression Criteria

Phase tests and return to play criteria for Evidence Based rehabilitation Protocol

- VAS for pain (30)
- Circumferential measurement with a measuring tape using the uninvolved leg as a control (30)
- Goniometer: for appropriate notation of AROM/PROM (30)
- The international knee documentation committee subjective knee form (IKDC) to measure symptoms and limitations in function (30,31)
- Hop tests: measures total leg function.
  - To detect performance limitations,
  - Minimum of two hop tests should be performed to increase sensitivity (30)
- Isokinetic tests: (30,31)
Progression Criteria
Phase tests and return to play criteria for Evidence Based rehabilitation Protocol

Rehab Goals: (phase appropriate)
- Subjective, objective, and as per physician protocol timeline
Return to sports:
- full ROM
- hop tests
- hamstring/quadriceps strength are 85% compared to the contralateral side
- difference in HS/quad strength ratio is less than 15% compared to the contralateral side
- patient tolerates sports specific activities (no increase in pain or swelling)
(6,11,24,41,44,51)

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Special Considerations

**Quadriceps strength**

- Open Kinetic Chain versus Closed Kinetic Chain
- NMES versus Isotonic
  - Eccentric, concentric
Special Considerations

**Neuromuscular (NM) Control**

- NM deficits after ACLR—
  - Muscle weakness
  - Impaired dynamic joint motion
  - Abnormal NM control
  - Difficulty returning to sports
- NM Control (after ACL Injury an ACLR)
  - Quadriceps strength
  - HS activation
- Good NM control is a balance:
  - Strength
  - Mobility
  - Kinesthetic awareness
  - Efficient joint mechanics
  - Sufficiently adaptive motor control system (32)
SUMMARY

• Based on the literature:
  - Prehab is important and effective in addressing possible post-op challenges.
  - Proper progression should be based upon subjective information, objective information and protocol timelines.
  - Evidence based criteria for advancement should be utilized to maximize results.
  - Recruitment of quadriceps should be focused on endurance and transition to power.
  - Strength training should progress to include NM control and timing.
REFERENCES


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