

ACL reconstruction post op. rehab.

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One of the most common complications following ACL reconstruction is loss of motion, especially loss of extension. Loss of knee extension has been shown to result in a limp, quadriceps muscle weakness, and anterior knee pain. Studies have demonstrated that the timing of ACL surgery has a significant influence on the development of postoperative knee stiffness.

ACL reconstruction 의 가장 흔한 합병증은 운동의 제한, 특히 무릎 펴는 제한이다. 이는 다리를 절게하고, Quadriceps의 약화와 전방슬관절에 통증을 유발한다. 연구들은 수술의 시기가 무릎의 경직에 상당한 영향을 미친다고 말한다.

The risk of developing a stiff knee after surgery can be significantly reduced if the surgery is delayed until the acute inflammatory phase has passed, the swelling has subsided, a normal or near normal range of motion (especially extension) has been obtained, and a normal gait pattern has been reestablished.

급성염증기가 지나가기 전에 수술을 한 경우 수술 후 무릎 경직의 위험을 크게 줄일 수 있었고 부종도 빨리 가라앉고 동작(특히 펴)도 정상 혹은 정상에 가깝게 만들어졌으며 정상적인 보행 패턴도 다시 설정되었다.

Phase 1 (0-2 wks.) - Acute managements & Early motion start

- use clutches
- knee splint(혹은 보조기)

Goal

- Control Pain and Swelling
- Protect Healing Tissue
- Begin to Restore Range of Motion (ROM) Especially Full Extension
- make Good Quadriceps Activation

Cautions

- WBAT(weight bearing as tolerance) with Crutches for Patellar Tendon Graft
- PWB(partial weight bearing) with Crutches for Hamstring or Allograft
- Bledsoe Brace locked in extension with ambulation and sleeping
- Bledsoe Brace unlocked 0-90° when non-weight bearing

Exercises

- ROM exercises (w/o pain, 3~5sets in day)
 - Heel slide w/ assist. (hold 5~10 sec, 15~25 repetitions x 3~5 set.)
 - Lie on your back with brace off and slowly slide your foot toward your hips, as far as possible.
 - use foot to make greater motion.

- important thing is feel normal feel at front of the knee
 - **Seated knee flexion** (hold 5~10 sec. 10~20 repetitions x 3~5 set.)
 - seat on edge of chair or table with brace off and slowly knee flexion as possible w/o pain.
 - **ROM wall slide** (hold 5~10 sec. 15~25 repetitions x 3~5 set.)
 - Lie on your back with your involved foot up on the wall, with your brace off. Slowly slide the foot down the wall as far as possible
 - 건측 발이 아래.
 - **Extension on a bolster (Q-setting)** (hold 1~5 min, rest for 30~60 sec, 3~5 repetitions x 3~5 set)
 - 수건같은 물체를 발목(혹은 오금부)에 두고 무릎를 펴며 누른다.
 - 손으로 눌러 힘을 가할 수 있다.
 - Knee extension stretch & Quadriceps m, strengthening
 - **Prone hang** (hold 1~5 min, rest for 30~60 sec, 3~5 repeat x 3~5 set)
 - hamstring tendon을 사용한 경우 하면 안된다.
 - prone에서 다리를 밖으로 내어놓고 knee extension방향으로 힘을준다.
 - **patellar mobilization** (hold 2 sec, direction for 1 min x 3~5 set)
 - superior, inferior, medial, lateral 로 mobilization ⇒ hold end of the glide
 - prevent scar tissue
 - 하면 안될것 : tip or tilt
 - **Ankle Pumps** without resistance (20 Repetitions x 2 set)
 - **Strengthening exercises (w/o pain)**
 - Quad Set (20 repetition x 2-3 set)
 - SLR of 10~20 (repetition x 2-3 set)
 - Hip Abd/Add/Extension (against gravity)(10~20 Repetition x 2~3 set)
 - Standing or Prone Hamstring Curls (unless Hamstring Graft) (10~20 repetitions x 2~3 set)
 - T-Band Ankle Pumps (20~25 repetitions x 2~3 sets)
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Phase 2 (2~6 wks) - Basic strengthening & Proprioception

- use clutches ~ 4wks (환자에 따라 다르지만)
- cast or splint 혹은 보조기 착용.

Goal

- protection of healing tissue
- improve ROM Normalize
- gait mechanics Begin to make return of L/E
- strength especially quadriceps

Cautions

- Wean crutches with Patellar Tendon graft 슬개골건은 2주부터 목발 안쓴다.
- Hamstring and Allograft PWB for 4 wks post op. 슬괵근건과 동종이식은 4주간 사용.
- Progress to WBAT at 4 wks post op and wean crutches as appropriate. 체중부하주의
- OK to begin closed chain exercises, but maintain weight bearing restrictions with gait Bledsoe brace 0-90° with ambulation 과도한 굽힘에 주의
- Must stress proper gait 비정상적인 보행패턴에 주의

Exercises

- **Range of motion exercise (w/o pain)**
 - **Phase 1 exercises** ⇒ for achieve normal ROM
 - **Stationary bike** (minimal resistance) (5~10 min, no resistance)
 - 재건 부위에 부하가 가지 않도록 주의.
 - **Standing knee flexion** (hold 20~30 sec, 3 repetition x 3 set)
 - 의자를 뒤에 두고 서서 발이나 발가락을 의자 위로 무릎을 굽혀 올린다.
 - Slowly squat down ⇒ knee flexion
 - **Prone knee flexion** (hold 20~30 sec, 3 repetition x 3 set)
 - prone에서 contract abdominals to prevent hyperlordosis
 - 발을 엉덩이로 당긴다.
- **Strengthening exercise**
 - Continue Quad Sets (as needed for VMO activation)
 - Partial lunge
 - step back
 - Crunches
 - Bridge (both/single)
 - Continue 4 way SLR program (add ankle weight as needed)
 - Hamstring Curls (Patellar Tendon and Allograft Only)
 - Standing Terminal Knee Extension (Theraband-Y)
 - Mini Squat and/or Wall Slide Leg Press
 - Heel Raises
 - Single Leg Stance
 - CKC exercise 전에 무릎의 안정화를 확인.

Phase 3. (6~12 wks) - Dynamic Neuromotor Strength, Endurance and Coordination

- ~ 8wks ; splint or 보조기 (patients needs)
- hamstring tendon 쓴 경우에도 hamstring exercise 해도 된다.

Goal

- Avoid patellofemoral pain
- Full ROM and flexibility
- closed chain strength and proprioception

Cautions

- Continue to stress proper gait

- Must avoid patella femoral stress
- No pivoting or lateral movements
- No running

Exercises

- **ROM exercise** (+ flexibility)
 - 필요하다면, ROM exercises from phase 1
 - **Lower Extremity stretching** (Hamstring, Quadriceps, Calf, Glutes, Adductors, ITB, etc)
 - **Belt Stretch** (Calf/Hamstring) (Hold 30 seconds 3~5 repetitions)
- **Cardiopulmonary exercise** (20~30 min x 2~3 set)
 - 저항을 늘린 stationary bike



- 8wks~ : Elliptical.
- 6~8 wks : swimming
- **Strengthening** (20~30 repetition x 2~3 set)
 - 4 way SLR, Hamstring curl w/ weight at ankle.
 - Gym Equipment (Leg Press, Ham Curl, Multi-Hip)
 - Squats to 90° (possible with reach)
 - Begin Single Leg strengthening
 - Step Up Progressions (Forward Step Ups) ⇒ down은 patella tendon을 신장하므로 x
 - Static Forward/Backward Lunge
 - lateral/forward lunge walk
 - Step off
- **Proprioception**
 - Single leg stance
 - Static balance on Bosu, airex, balance board, etc

Phase 4. (12~16 wks) - Athletic Enhancement and Return to Activity

Goal

- Continue to avoid patella femoral pain
- Progress with single leg strengthening
- Achieve normal ROM
- strength to begin jogging and plyometric training

Cautions

- Straight ahead running only
- No pivoting or cutting
- No sports

Exercises

- **ROM & stretch**
 - Daily stretching (30sec, 2~3 repetition)
 - **Cardiopulmonary exercise** (20~40 min, 3~5 times a week)
 - Cycle, elliptical, swimming
 - running progression
 - **Strengthening** (15~20 repetition x 2~3 set, 3 times a week)
 - 4 way SLR programs & Gym equipment progression
 - lateral / crossover step-up exercise
 - Dynamic / lateral lunge
 - Single leg strengthening (single leg squat/split squat/single leg dead lift)
 - **Proprioception** (15~20 repetition x 2~3 set, 3 times a week)
 - Dynamic balance (Bosu, foam, etc)
 - **Dynamic progression** (2 times a week)
 - Plyometric
 - Jump
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Phase 5. (16~24 wks) - Sports Performance and Injury Prevention

Goal

- Full ROM, flexibility and strength
- progressive/dynamic strengthening, proprioceptive, plyometric and agility training
- strength to begin return to sport

Cautions

- Limited and controlled lateral movements
- Gradual return to sport pending surgeon's clearance (6 months or greater)
- Physical Therapist to develop specific return to sport progression

Exercises

- **Stretching**
 - Daily L/E stretch
- **Cardiopulmonary exercise**
 - increase intensity / duration
- **Strengthening**
 - increase load / decrease volume
 - Fast feet exercise

- Forward lunge walk with rotation
 - Power step
 - Core exercises (Bridge, plank, lateral plank)

 - **proprioception**
 - increase difficulty of drills
 - **Dynamic progression**
 - Plyometric / jumping
 - jump rotation (Perform a squat jump, while in the air turn 90°)
 - multi planar leap and land (한다리점프 양다리 착지)
 - Hopping (한다리 점프, 한다리 착지)
 - Power bounce
 - Speed / agility program
 - Stop and go
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Plyometric / Jumping progression

Simple Double Limb (12-16 Weeks Post Op) *Limit 60 foot contacts per workout

- Double Leg Hops (forward and backward over line)
- Box Jump (6-8 inches max)
- *Focus on sticking each landing with good form in frontal and sagittal planes. Stress a soft landing with good eccentric control.*

Complex Double Limb (16-20 Weeks Post Op) *Limit 90 foot contacts per workout

- Double Leg Jump (for distance)
- Double Leg Jump (for height)
- Double Leg Jump (with 90° or 180° turn)
- Double Leg Lateral Jump/Lateral Box Jump (side to side)
- Depth Jump (6-8 inches max)
- *Focus on sticking each landing with good form in frontal and sagittal planes. Stress a soft landing with good eccentric control.*

Combination Jumps (begin at 18-20 weeks post op)

- Repetitive Double Leg Jumps (distance, height, lateral, turns)
- Jump for Distance into Jump for Height
- Box Jump to Depth Jump
- Depth Jump to Jump for Distance/Height
- *String jumps together. Focus on quickly moving from jump to jump.*

Single Limb (20-24 Weeks Post Op) *Limit 100-120 foot contacts per workout

- Heiden Hop Bounding
- Single Leg Jumps (distance, height, lateral, 90°/180° turn)
- Single Leg Box Jumps (6-8 inches max)
- Single Leg Depth Jumps (6-8 inches max)

Focus on sticking each landing with good form in frontal and sagittal planes. Stress a soft landing with good eccentric control.

- **Combination Jumps (Single Leg)**

- Repetitive Single Leg Jumps (distance, height, lateral, 90°/180° turn)
- Jump for Distance into Jump for Height
- Box Jump to Depth Jump
- Depth Jump to Jump for Distance/Height

String jumps together. Focus on quickly moving from jump to jump.

Speed / Agility progression

Work with P.T. to establish proper warm-up and cool down before and after each workout agility session.

Forward/Backward Sprinting (16-20 Weeks)

- **Week 1:** Sprint 50-100 yards at ½ speed 10 reps.
- **Week 2:** Sprint 50-100 yards at ½ speed 5 reps. Sprint 50-100 yards at ¾ speed 10 reps
- **Week 3:** Sprint 100 yards at ½ speed 2 reps. Sprint 100 yards at ¾ speed 5 reps. Sprint 50-100 yards at full speed 5 reps. Backpedal 50 yards at ½ speed 5 reps.
- **Week 4:** Sprint 100 yards at ½ speed 1 rep. Sprint 100 yards at ¾ speed 2 reps. Sprint 50 yards at full speed 5 reps and 100 yards at full speed 5 reps. Backpedal 50 yards at ¾ speed 5 reps.

Basic Change of Direction (20-24 Weeks)

*Begin each workout with sprinting and backpedaling 50 yards (2 reps at ½ speed, 5 reps at full speed)

- **Week 5:** T drill 3 reps at ½ speed, forward/backpedal shuttle 5/10/20 yard 3 reps at ½ speed
- **Week 6:** T drill 3 reps full speed, forward/backpedal shuttle 5/10/20 yards 3 reps full speed, box drill with shuffling 3 reps at ½ speed
- **Week 7:** Box drill with shuffling 3 reps at full speed, 10 yard shuttle run (quick direction change) 3 reps at full speed, Z drill 6 reps at ¾ speed
- **Week 8:** Box drill with cuts 3 reps at full speed, 10 yard shuttle run (quick direction change) 3 reps at full speed, Z drill 6 reps at full speed

Advanced Drills (24 Weeks and Beyond)

*Begin each workout with sprinting and backpedaling 50 yards (2 reps at ½ speed, 5 reps at full speed)

Work with P.T. to develop sport specific drills. Perform drills from previous weeks with use of ball, stick, etc. Perform drills seen in typical sports practice with supervision.