The Gundersen Health System Sports Medicine ACL Reconstruction Rehabilitation Program is an evidence-based and soft tissue healing dependent program allowing patients to progress to vocational and sports-related activities as quickly and safely as possible. Individual variations will occur depending on surgical technique and the patient’s response to treatment. Not all patients will utilize a post-operative brace. If a meniscus repair is performed in conjunction with the ACL reconstruction, follow the meniscus repair program for the first 6-8 weeks and then transition to the ACL reconstruction program. If a hamstring/gracilis autograft is utilized, avoid isolated hamstring strengthening for 6 weeks. If a patellar tendon graft is utilized, work on patella mobilizations to prevent excessive scarring. If an allograft is utilized, patients may need to be cautioned not to advance too quickly as post-operative pain may be less.

Please contact us at 1-800-362-9567 ext. 58600 if you have questions or concerns.

<table>
<thead>
<tr>
<th>Phase I: 0-6 weeks</th>
<th>Immediate post op maximum protection phase</th>
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<tbody>
<tr>
<td><strong>Goals</strong></td>
<td>• Protect surgical graft</td>
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<tr>
<td></td>
<td>• Minimize knee joint effusion</td>
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<tr>
<td></td>
<td>• Gently increase ROM per guidelines, emphasis on extension</td>
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<td></td>
<td>• Encourage quadriceps function</td>
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<td></td>
<td>• Prevent negative effects of immobilization</td>
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<td></td>
<td>• Normalization of walking with good heel-to-toe pattern</td>
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<tr>
<td><strong>Brace</strong></td>
<td>• Not all patients will utilize a post-operative brace.</td>
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<tr>
<td></td>
<td>• wks 0-1: 0-90 deg, locked for ambulation and sleeping</td>
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<td></td>
<td>• wks 1+: 0-120 deg, unlocked for ambulation when good quadriceps control and ext ROM</td>
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<td>• wk 4: D/C brace</td>
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<tr>
<td><strong>ROM</strong></td>
<td>• wks 0-2: 0-90 degrees, emphasis on extension initially with gradual progression of flexion</td>
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<td>• wks 2-3: 0-110 degrees</td>
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<td>• wks 3-4: 0-120 degrees</td>
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<td></td>
<td>• wks 6+: Full ROM</td>
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<tr>
<td><strong>WB</strong></td>
<td>• wk 0-1: WBAT with brace locked into extension</td>
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<td>• wk 1-4: WBAT with brace unlocked if good quadriceps control and knee extension ROM. D/C crutches when can ambulate with normal heel-to-toe pattern.</td>
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<tr>
<td><strong>Precautions</strong></td>
<td>• If hamstring/gracilis autograft, no isolated resistance to knee flexion until wk 6. Start isometrics at wk 5. Progress to isotonics at wk 6. Also apply ice to posterior knee to minimize muscle spasm.</td>
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<td>• Encourage AROM and WB to promote healing, prevent atrophy of soft tissue and bone, prevent a decrease in collagen content, and to align fibroblast and collagen fibrils.</td>
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<td>• Emphasis on regaining extension ROM ASAP to prevent arthrofibrosis and decrease stress to the PF joint during ambulation.</td>
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<td>• Avoid descending stair reciprocally until adequate quadriceps control and lower extremity alignment</td>
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<td>• Avoid twisting and pivoting motions for 6-8 weeks to minimize shear forces to the healing graft.</td>
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<td></td>
<td>• Avoid any isolated OKC resisted knee extension until 6 weeks</td>
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<tr>
<td><strong>Modalities</strong></td>
<td>• Cryotherapy 15 minutes in duration 3x/day</td>
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<td></td>
<td>• IFC for pain/effusion if needed</td>
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<td>• NMES quadriceps if needed</td>
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</tbody>
</table>
### Treatment Recommendations

**Guidelines for progression based on tolerance**

- Active warm-up (Bike AAROM progress to Bike with resistance, Nu Step)
- Stretching to attain full extension with gradual progression of flexion. Goal of full ROM by wk 6. Emphasis on full return of knee extension ASAP. Low-load long duration stretching for extension with heat if needed (1<sup>st</sup> TERT= Total End Range Time)
  - Manual stretching for extension with overpressure / recurvatum
  - Patellar mobilizations
  - PROM / AAROM / AROM
  - Manual stretching into flexion (initially limited by knee joint effusion)
    - wk 4: WB stretch on leg press for knee flexion ROM
- Flexibility exercises for hamstring, gastoc-soleus
- Scar tissue massage
  - Biofeedback QS, SLR (if no lag), CKC knee extension
  - Hip 4 way SLR, sidelying hip ER
  - Gastroc soleus strengthening
  - Hamstring OKC isotonics 0-90 deg in seated position
  - CKC exercises: Heel raises, weight shifts, leg press and wall squats (0-60 deg)
    - wk 2: Leg press and wall squats (0-90 deg), lateral step-overs, step-ups, partial BW squats with UE support as needed, retro TM walking for knee ext, forward TM walking for gait training
    - wk 3: Partial lunges front and lateral, leg press 2:1, BW squats progress ROM and balance
    - wk 4: Elliptical Runner, leg press 2:1 and 1:1
    - wk 5: Resisted sidestep with T-band, partial dead lifts, Bosu partial squats 0-60 deg
- Total leg strengthening
- Balance / Proprioception training: Double leg progress to single leg, static progressing to dynamic activities. Perturbation exercises
  - CV conditioning / Core Stability
  - IFC for pain/effusion, NMES for quadriceps activation and control as needed
  - Ice (in stretch for extension if needed) 2<sup>nd</sup> TERT
  - HEP for 3<sup>rd</sup> TERT

### Phases of graft remodeling

- Revascularization and ligamentization occur over 12 month period with peak maturity evident between 6 to 12 months following surgery.
  - wk 0-3: Graft necrosis with gradual replacement cells. Graft is nourished by synovial fluid so ROM is crucial.
  - wk 1-6-16: Graft revascularization begins, continuing through wk 16.
    - (Based on canine study)
  - wk 3-24: Cellular repopulation begins, continuing through wk 24.
  - wk 6-52: Collagen structural formation with remodeling occurring up to 1 year.
### Phase II: 6-12 weeks

**Goals**
- Minimize knee joint effusion
- Gently increase ROM with goal of full ROM by 6-8 weeks
- Gradual progression of therapeutic exercises for strengthening, stretching, and balance
- Implement low level foot placement/agility drills working on control

| ROM / Brace | • Progress to full ROM by 6-8 weeks.  
|             | • Knee sleeve may be utilized depending on patient activities |
| Modalities  | • Cryotherapy 15 minutes in duration 1-2x/day  
|             | • IFC for pain/effusion if needed. NMES quadriceps if needed |

**Precautions**
- Avoid overloading the fixation site by utilizing low amplitude low velocity movements.
- Avoid quick twisting and pivoting motions for 10-12 wks to minimize shear forces.
- Implement quadriceps isotonic strengthening from 30-90 deg to avoid shear forces to the healing graft.
- Implement low level foot placement/agility drills focus on control at week 9.

**Treatment Recommendations**

**Guidelines for progression based on tolerance**
- Active warm-up: Bike with resistance, Nu Step, Treadmill walking
- Stretching for full extension and flexion as needed.
  - Low-load long duration stretching with heat if needed
  - (1st TERT= Total End Range Time)
  - Manual stretching for extension and/or flexion
  - Leg press stretch for flexion
- Flexibility exercises for hamstring, gastoc-soleus, iliopsoas,
- Therapeutic exercises: Exercise in a pain-free manner. Avoid dynamic valgus during strengthening and functional activities. Incorporate total leg strengthening, focus on hip/glutes, quadriceps, and hamstring. Progress with balance/proprrioception exercises. Progress with double leg and single leg exercises, adding in external focus of attention (ball catch, plyo-back throws). Work on advanced gait drills. Work on weight acceptance and control (shallow squats with lateral shifting, with sagittal shifting, with shallow arc motions). Progress to foot placement drills and low-level agility exercises.
  - Total leg strengthening and CV conditioning
  - Hip and core strengthening to prevent knee valgus
  - Heel raises
  - Hamstrings isotonics prone 0-90 deg.
  - Balance / Proprioception training: Single leg stance activities static progressing to dynamic activities. Perturbation exercises
  - CKC exercises: Leg press 1:1, step-ups/step downs, squats, shallow squats with lateral shifting, Split squats, squat progression double leg to single leg, Bosu squats, lunge progression, deadlifts, sidestep/sideshuffle with T band
  - wk 8: Euroglide, hamstring curls with physio ball
  - wk 9: Quadriceps isotonics 30-90 deg if minimal chondrosis Isokinetic quadriceps/hamstrings 30-90 deg; VSRP 180-300 deg/sec sub-max to max; progressing to 60-300 deg/sec
  - Low level agility working on control / foot placement drills starting at wk 9
  - IFC for pain/effusion / NMES for quadriceps activation and control as needed
  - Ice (in stretch if needed) 2nd TERT
  - HEP for 3rd TERT if needed
  - wk 12: Can progress to independent strengthening program with monthly or bi-monthly visits if good ROM, minimal effusion, and good muscle control.

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**Independent strengthening**
<table>
<thead>
<tr>
<th>Phase III: 12+ wks</th>
<th>Advanced Strengthening and Return to activity phase</th>
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</table>
| **Goals**         | • Progress muscle strength, endurance, and balance activities. Ideally 3x/week of exercises at a fitness center, step-down, or home program  
|                   | • Progress to higher level activities depending on functional demands and MD approval  
|                   | • Initiate a return to running program at 3-4 months if passes criteria and has no complications with running pattern.  
|                   | • Initiate working on landing mechanics and control at 12-14 weeks  
|                   | • Progress agility drills and eventual progression to sport specific drills.  
|                   | • Return back to vocational, recreational, and sport activities. **Return to sports activity at 9-12 months if passes criteria.** Sports progression may take 2-4 weeks for full clearance back to full competition |
| **Brace**         | • Your MD may recommend a knee sleeve or functional brace to be used until 12 months from your surgery for higher level activities |
| **Modalities**    | • Cryotherapy 15 minutes 1x/day or after strenuous activity |
| **Treatment**     | • Active warm-up: Bike, Elliptical Runner, Treadmill walking,  
| **Recommendations** | • Continue with stretching and flexibility exercises as needed  
|                   | • Strengthening and endurance exercises: Advance as tolerated with emphasis on functional strengthening. Avoid dynamic valgus during strengthening and functional activities. Incorporate total leg strengthening, focus on hip/glutes, quadriceps, and hamstring. Progress with balance / proprioception exercises. Progress agility drills and working on landing mechanics. Progress to sports specific activities.  
|                   | • Total leg strengthening: hip/quadriceps/hamstring  
|                   | • Hip strengthening – neuromuscular control to prevent knee valgus  
|                   | • Core strengthening – prevent frontal plane trunk lean during landing/SLS  
|                   | • Heel raises  
|                   | • Hamstring full ROM isotonics  
|                   | • CKC exercises: lunge progression, squat progression, step-up/downs  
|                   | • progress with double leg / off-set foot position / single leg  
|                   | • progress single direction to multiple directions.  
|                   | • Balance exercises: Single leg, progress to dynamic and reactive  
|                   | • Return to running program if passes criteria- see next page  
|                   | • 4 months: Quadriceps isotonics 0-full flexion if minimal chondrosis  
|                   | • Isokinetic quads/hams 0-full flexion if minimal chondrosis |
| **Return-to-Sports Progression:** (2-4 weeks, depending on tolerance) | • 12-14 weeks: progress to the following exercises if clinical appropriate  
|                   | • Low amplitude low velocity agility drills:  
|                   | • skipping F/B, jogging F/B, skaters, carioca  
|                   | • Low amplitude landing mechanics and drills  
|                   | • Shallow jump landings, double to single line jumps, squat jumps, |
|                   | • 4 months-5 months: progress with:  
|                   | • Landing mechanics drills: progress to higher level:  
|                   | • double progress to single leg. single plane progress to multi-plane.  
|                   | • Focus on: soft landing with knee flexion, no medial collapse/knee valgus, postural stability,  
|                   | • Agility drills: progress to higher level with speed and complexity:  
|                   | • agility ladder drills, cutting/pivoting (changing directions), changing speeds, anticipated to un-anticipated  
|                   | • 6 months +:  
|                   | • Strength and control drills related to sport specific movements  
|                   | • Progress with agility and jumping/hopping drills  
|                   | • 9 months+: possible clearance for return to sport, depending on testing -see next page for testing algorithm |

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ACL Return-to-Running and Return-to-Play Testing Algorithm

**6 weeks**
1. Knee ROM
2. Hip strength:
   - Abduction MMT
   - Hip Abduction Side plank Test
3. SL 30 deg Stork test
4. FOTO

**8 weeks**
1. Knee ROM
2. Hip strength:
   - Abduction MMT/dynamometry
   - Hip Abduction Side plank test
3. SL 30 deg Stork test
4. Y balance

**12 weeks (3 months) – possible return to running**
1. SL 60 deg Stork test
2. Hip strength:
   - Abduction MMT/dynamometry
   - Hip Abduction Side plank test
3. Biodex test:
   - 20 deg extension block
   - 2 speeds: 180 deg/sec (5 reps) 300 deg/sec (30 reps)
4. Y balance test
5. Squat WB symmetry: Force plate
6. FOTO

*if adequate strength scores for return to running*  
(quads at least 75%, hamstrings: at least 80%)
1. Anterior lateral hop to stabilization
2. Jump test: no arm swing – sub-max for apprehension
3. Single Hop test: no arm swing- sub-max for apprehension
4. Trial of running

**16 weeks (4 months) – RETURN to RUNNING**
Repeat previous tests not passed
1. Anterior lateral hop to stabilization
2. Jump test: no arm swing – sub-max for apprehension
3. Single Hop test: no arm swing- sub-max for apprehension
4. Trial of running

**Return to running and return to play**
depends on:
- Timeframe from surgery
- Test performance
- MD and PT approval

**Return to Running Criteria:**
1. Time: at least 3-4 months post-op
2. MD / PT clearance
3. No knee joint effusion
4. ROM: limb symmetry: 
   - extension within 5 deg
   - flexion within 10 deg
5. Biodex:
   - Limb symmetry of PT:
     - Quad: 75%
     - Hams: 80%
6. Squat WB symmetry with near equal WB
7. Anterior lateral hop to stabilization drill completed with no apprehension and good movement control
8. Proper running form: Treadmill running (6-10 mph, 5 min) with equal audibly rhythmic foot strike

**Return to Running Recommendations:**
1. Biodex:
   - 180 deg/sec:
     - Quad PT/BW: Males: 65%
     - Females: 55%
     - H/Q ratio: 65%
   - 300 deg/sec:
     - Quads Power: Limb symmetry: 75%
     - Hams Power: Limb symmetry: 75%
2. SL 60 deg stork test:
   - Limb symmetry: 90%
3. Hip Abduction Side Plank test:
   - Level II or greater
4. Y balance: Limb symmetry: < 4cm
ACL Return-to-Running and Return-to-Play Testing Algorithm

20 weeks (6 months)
1. Biodex test: Full ROM with no ext block  
   3 speed test:  60 deg/sec (5 reps),  
   180 deg/sec (5 reps),  
   300deg/sec (30 reps)
2. Squat WB symmetry: force plate
3. Landing Assessment: qualitative*  
   a. Land Vertical Jump – 2D (front and side)  
   b. Single leg Hop sub-max – 2D (front and side)  
      (no arm swing. 50% distance of un-involved side)
4. FOTO and IKDC (Mycare)

Landing mechanic variables at impact for potential injury risk:
1. Stiff landing (< 30 deg knee flexion)
2. Knee valgus
3. Hip IR / pelvic drop
4. Decreased postural stability / decreased dynamic balance

9 months- Possible return to sport
1.Knee ROM
2.Biodex test: Full ROM with no ext block  
   3 speed test:  60 deg/sec (5 reps),  
   180 deg/sec (5 reps),  
   300deg/sec (30 reps)
3.Hip Abduction strength: Side Plank test or Dynamometry
4. Landing Assessment: qualitative and quantitative*  
   a. Single leg hop (no arm swing) – 2D (front and side)  
   b. Triple hop (arm swing) – 2D (front)
   c. Cross-over hop (arm swing) – 2D (front)
5. Agility test: LEFT test components or time
6. FOTO and IKDC (Mycare)

Landing mechanic variables at impact for potential injury risk:
   Qualitative:
1. Stiff landing (< 30 deg knee flexion)
2. Knee valgus
3. Hip IR / pelvic drop
4. Decreased postural stability / decreased dynamic balance
   Quantitative:
1. Increased number of repetitions
2. Limb symmetry of < 90%

1 year / 2 year
Biodex 3 speed test (5,5,30 reps)
Landing Assessments
Agility test: LEFT test components or time
FOTO and IKDC (Mycare)

Return to Play Criteria:
1. Time: at least 9-12 months
2. MD/ PT clearance
3. No knee joint effusion
4. ROM: limb symmetry:  
   extension within 5 deg  
   flexion within 10 deg
5. Biodex: Limb symmetry of PT:  
   Quad: 90%  
   Hams: 90%

6. Landing Assessment:  
   (Single Hop/ Triple Hop/ Cross-over Hop)  
   Quantitative: Limb symmetry: 90%  
   Qualitative: no faulty landing mechanics
7. Agility components with no compensation

Return to Play Recommendations:
1. Biodex:  
   60 deg/sec:  
   Quad PT/BW: Males: 100%  
   Females: 80%  
   Hams PT/BW: Males: 60%  
   Females: 60%  
   H/Q ratio: 60 deg/sec : 60%  
   180 deg/sec: 70%  
   300 deg/sec: 80%

300 deg/sec:  
   Quads Power : Limb symmetry:90%  
   Hams Power: Limb symmetry: 90%
2. Hip Abduction Side Plank test:  
   Level III or greater
3. Y balance: Limb symmetry: < 4cm

Return to Sports Activity Progression: (2-4 wks)
1. 1 on 1 drills (non-contact) sport specific activities
2. 1 on 1 drills (contact) full speed sport specific activities
3. Team scrimmage (non-contact)
4. Team scrimmage no restrictions
5. Game activities with restricted playing time
6. Game activities with no restrictions
ACL Reconstruction Program References


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