

Noyes Knee Institute Rehabilitation Protocol for ACL Reconstruction:
Revision Knees, Allografts, Complex Knees

	Postoperative Weeks					Postoperative Months			
	1-2	3-4	5-6	7-8	9-12	4	5	6	7-12
Brace: postoperative & functional	X	X	X	X	(X)			X	X
Range of motion minimum goals: 0°-90° 0°-120° 0°-135°	X	X	X	X					
Weight bearing: Toe touch 1/4 - 1/2 body weight 3/4 - Full	X	X	X						
Patella mobilization	X	X	X						
Modalities: Electrical muscle stimulation Pain/edema management (cryotherapy)	X	X	X	X	X	X	X	X	X
Stretching: Hamstring, gastroc-soleus, iliotibial band, quadriceps	X	X	X	X	X	X	X	X	X
Strengthening: Quad isometrics, quad-ham isometrics co-contraction, straight leg raises, active knee extension Closed-chain: gait retraining, toe raises, wall sits, mini-squats Knee flexion hamstring curls (90°) Knee extension quads (90°-30°) Hip abduction-adduction, multi-hip Leg press (70°-10°)	X	X	X	X	X	X			
Balance/proprioceptive training: Weight-shifting, cup walking, BBS BBS, BAPS, perturbation training, balance board, mini-trampoline	X	X	X	X	X	X	X	X	X
Conditioning: UBC Bike (stationary) Aquatic program Elliptical machine Swimming (kicking) Walking Stair climbing machine Ski machine		X	X	X					
Running: straight								X	X
Cutting: lateral carioca, figure 8's									X
Plyometric training									X
Full sports									X

BAPS = Biomechanical Ankle Platform System (Camp, Jackson, MI), BBS = Biodex Balance System (Biodex Medical Systems, Inc, Shirley, NY), UBC = upper body cycle (Biodex Medical Systems, Inc, Shirley, NY).

SOURCE: Heckmann T, Noyes FR, Barber-Westin SD: Rehabilitation of primary and revision anterior cruciate ligament reconstructions. *Noyes' Knee Disorders: Surgery, Rehabilitation, Clinical Outcomes*, Saunders, Philadelphia, 2009, pp. 306-336.

Phase 2. Weeks 3 to 4

General Observation	50% weight bearing when: - Pain controlled - Hemarthrosis controlled - Voluntary quadriceps contraction achieved	
Evaluation	Pain Effusion Patellar mobility ROM minimum Quadriceps contraction & patella migration Soft tissue contracture Joint arthrometer (3 weeks, 20 lbs)	Goals Controlled Mild Good 0°-90° Good None < 3 mm
<p>Frequency 3-4 x/day 10 minutes</p> <p>2-3 x/day 20 minutes</p> <p>2 x/day 10 minutes</p> <p>As required</p>	<p>Range of motion Range of motion passive, 0°-90° Patella mobilization Ankle pumps (plantar flexion with resistance band) Hamstring, gastroc-soleus stretches</p> <p>Strengthening Straight leg raises (flexion, extension, adduction) Isometric training: Multi-angle (0°, 60°) Active quadriceps (full extension) Quad/ham co-contraction with EMS Toe raises/heel raises Knee extension (90°-45°, no resistance) Knee flexion (active, 0°- 90°) Multi-hip machine (flexion, extension, abduction, adduction) Leg press (70°-10°) Closed-chain - Mini-squats (0°-45°, 50% weight bearing) - Wall sits - Wall sits with EMS</p> <p>Aerobic conditioning UBC</p> <p>Modalities Electrical muscle stimulation Cryotherapy</p>	<p>Duration</p> <p>5 reps x 30 secs</p> <p>3 sets x 10 reps</p> <p>1 set x 10 reps</p> <p>3 sets x 10 reps</p> <p>3 sets x 10 reps</p> <p>3 sets x 10 reps</p> <p>3 sets x 10 reps</p> <p>3 sets x 10 reps</p> <p>3 sets x 20 reps to fatigue</p> <p>20 minutes</p> <p>20 minutes</p>
Goals	Range of motion 0°-110° Control inflammation, effusion Adequate quadriceps contraction 50% weight bearing	

Phase 3. Weeks 5 to 6

General Observation	Full weight bearing when: - Pain controlled without narcotics - Effusion controlled - ROM 0°-100° - Muscle control throughout ROM - Dynamic control varus/valgus	
Evaluation	Pain Effusion Patellar mobility Range of motion Muscle control Inflammatory response Joint arthrometer (6 weeks, 30 lb.s)	Goals Mild Minimal Good 0°-120° 3/5 None < 3 mm
<p>Frequency 3 x/day 10 minutes</p> <p>2-3 x/day 20 minutes</p> <p>3 x/day 5 minutes</p> <p>1-2 x/day 5 minutes</p> <p>2 x/day 10 minutes</p> <p>As required</p>	<p>Range of motion Range of motion passive, 0°-120° Patella mobilization Ankle pumps (plantar flexion with resistance band) Hamstring, gastroc-soleus stretches</p> <p>Strengthening Straight leg raises (ankle weight, < 10% of body weight) Isometric training: multi-angle (90°, 60°, 30°) Heel raise/toe raise Hamstring curls (active, 0°-90°) Knee extension (90°-45°, with resistance) Closed-chain - Wall sits - Mini-squats - Lunge (no resistance) Multi-hip machine (flexion, extension, abduction, adduction) Leg press (70°-10°)</p> <p>Balance training Weight shift side/side and forward/back Balance board/2 legged Cup walking Single leg stance – stable platform</p> <p>Aerobic conditioning UBC Water walking Stationary bicycling (patellofemoral precautions)</p> <p>Modalities Electrical muscle stimulation Cryotherapy</p>	<p>Duration</p> <p>5 reps x 30 secs</p> <p>3 sets x 10 reps 2 sets x 10 reps 3 sets x 10 reps 3 sets x 10 reps 3 sets x 10 reps</p> <p>5 reps 3 sets x 20 reps</p> <p>3 sets x 10 reps 3 sets x 10 reps</p> <p>5 sets x 10 reps</p> <p>5 reps</p> <p>20 minutes 20 minutes</p>
Goals	ROM 0°-125° Control inflammation, effusion Muscle control Full weight bearing Early recognition complications (motion loss, RSD, increased AP displacement, patellofemoral)	

Phase 4. Weeks 7 to 8

General Observation	Independent ambulation when: - Pain controlled - ROM 0°-120° - Dynamic control varus/valgus - Effusion controlled - Muscle control throughout ROM	
Evaluation	Pain Effusion Patellar mobility Range of motion Muscle control Inflammatory response Gait Joint arthrometer (8 weeks)	Goals No RSD Minimal Good 0°-135° 4/5 None Symmetrical < 3 mm
<p>Frequency 2 x/day 10 minutes</p> <p>2 x/day 20 minutes</p> <p>3 x/day 5 minutes</p> <p>2 x/day 10 minutes</p> <p>As required</p>	<p>Range of motion Hamstring, gastroc-soleus stretches</p> <p>Strengthening Straight leg raises (ankle weight, < 10% body weight) Straight leg raises, rubber tubing Isometric training: multi-angle (90°, 60°, 30°) Heel raise/toe raise Hamstring curls (active, 0°-90°) Knee extension with resistance (90°-45°) Leg press (70°-10°) Closed-chain - Wall sits - Mini-squats (rubber tubing, 0°-30°) - Lunge Multi-hip machine (flexion, extension, abduction, adduction) Leg press (70°-10°)</p> <p>Balance training Balance board/2 legged Lateral step-ups: 2-4"</p> <p>Aerobic conditioning (patellofemoral precautions) UBC Stationary bicycling Water walking Stair machine (low resistance, low stroke) Ski machine (short stride, level, low resistance) Elliptical machine (low resistance)</p> <p>Modalities Cryotherapy</p>	<p>Duration 5 reps x 30 secs</p> <p>3 sets x 10 reps 3 sets x 30 reps 3 sets x 20 reps 3 sets x 10 reps 3 sets x 10 reps 3 sets x 10 reps 3 sets x 10 reps</p> <p>3 sets x 20 reps to fatigue x 3</p> <p>3 sets x 10 reps 3 sets x 10 reps</p> <p>20 minutes</p>
Goals	ROM 0°-135° Full weight bearing, normal gait Control inflammation, effusion Muscle endurance Recognize complications (motion loss, RSD, increased AP displacement) Recognition patellofemoral changes	

Phase 5. Weeks 9 to 12

General Observation	Full weight bearing ROM 0°-135° No effusion, painless ROM, joint stability Performs ADL, can walk 20 minutes without pain	
Evaluation	Manual muscle test Hamstrings, quadriceps, hip abductors/adductors/flexors/extensors Swelling Joint arthrometer (12 weeks) Patellar mobility Crepitus	Goals 4/5 None 3 mm Good None/slight
<p>Frequency 2 x/day 10 minutes</p> <p>2 x/day 20 minutes</p> <p>3 x/day 5 minutes</p> <p>1-2 x/day 15-20 minutes</p> <p>As required</p>	<p>Range of motion Hamstring, gastroc-soleus, quad, ITB stretches</p> <p>Strengthening Straight leg raises, rubber tubing Hamstring curls (active, 0°-90°) Knee extension with resistance (90°-45°) Leg press (70°-10°) Closed-chain - Wall sits - Mini-squats (rubber tubing, 0°-40°) - Lunge Multi-hip machine (flexion, extension, abduction, adduction)</p> <p>Balance training Balance board/2 legged Single leg stance – unstable platform Perturbation training</p> <p>Aerobic conditioning (patellofemoral precautions) Stationary bicycling Water walking Swimming (straight leg kicking) Walking Stair machine (low resistance, low stroke) Ski machine (short stride, level, low resistance) Elliptical machine (low resistance)</p> <p>Modalities Cryotherapy</p>	<p>Duration</p> <p>5 reps x 30 secs</p> <p>3 sets x 30 reps 3 sets x 10 reps 3 sets x 10 reps 3 sets x 10 reps 3 sets x 20 reps to fatigue x 3</p> <p>3 sets x 10 reps 3 sets x 10 reps</p> <p>20 minutes</p>
Goals	Increase strength and endurance	

Phase 7. Weeks 27 to 52

General Observation	No effusion, painless ROM, joint stability Performs ADL, can walk 20 minutes without pain	
Evaluation	Isokinetic test (isometric + torque 300°/sec, % diff quads & hams) Swelling Joint arthrometer Patellar mobility Crepitus Single-leg function tests (9 mos: hop distance, timed hop, % inv/uninv)	Goals 10-15 None 3 mm Good None/slight 85
Frequency		Duration
2 x/day 10 minutes	Range of motion Hamstring, gastroc-soleus, quad, ITB stretches	5 reps x 30 secs
1 x/day 20-30 minutes	Strengthening Straight leg raises, rubber tubing (high speed) Hamstring curls (active, 0°-90°) Knee extension with resistance (90°-45°) Leg press (70°-10°) Multi-hip machine (flexion, extension, abduction, adduction)	3 sets x 30 reps 3 sets x 10 reps 3 sets x 10 reps 3 sets x 10 reps 3 sets x 10 reps
3 x/day 5 minutes	Balance training Balance board/2 legged Single leg stance Perturbation training	
3 x/week 20-30 minutes	Aerobic conditioning (patellofemoral precautions) Stationary bicycling Water walking Swimming (kicking) Walking Stair machine (low resistance, low stroke) Ski machine (short stride, level, low resistance)	
3 x/week 15-20 minutes	Running program (straight,) Jog – interval training (20, 40, 60, 100 yards) Walk Backward run	1/4 mile 1/8 mile 20 yards 20 yards
3 x/week	Cutting program – lateral, carioca, figure 8's (20% deficit isokinetic test)	
3 x/week	Functional training Plyometric training: box hops, level, double-leg Sport specific drills (10-15% deficit isokinetic test)	15 secs, 4-6 sets
As required	Modalities Cryotherapy	20 minutes
Goals	Increase function, strength, endurance Return to previous activity level	