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## **ACCELERATED REHABILITATION PROTOCOL ANTERIOR CRUCIATE LIGAMENT (ACL) RECONSTRUCTION**

The purpose of this protocol is to provide the physicians, therapists and other care providers with a guideline of the post-operative rehabilitation course. This rehabilitation protocol has been formulated for ACL reconstruction patients with patellar tendon (BTB) autograft or hamstring autograft.

A delayed protocol is utilized for ACL reconstruction with allograft, meniscal repair, other ligament reconstruction, in revision settings, or with cartilage repair/restoration.

### **Goals of ACL reconstruction:**

1. Diminish inflammation, pain and swelling
2. Obtain normal knee range of motion (focus on knee extension)
3. Regain voluntary muscle activation
4. Obtain normal proprioception, balance and coordination for ADLs
5. Return to sport

### **During your postoperative course, it is imperative to be mindful of:**

1. Persistent swelling
2. Abnormal pain or hypersensitivity
3. Limited range of motion
4. Weakness of quadriceps
5. When hamstring autograft is used: avoid active hamstring exercises until 6 weeks postop – use towel for heel slides

### **Return to sport/activity**

This is dependent on time and clinical progression. A typical return to sport timeline for autograft ACL is 6-9 months after surgery. For allograft ACL, it is typically 9-12 months. Full return to activity requires good strength, flexibility and endurance.

This includes single leg hop test (90% of contralateral side) and completion of the SportsMetrics Return to Play program (pages 10-11, autograft start weeks 20-24, allograft weeks 24-28).

	Postoperative Weeks					Postoperative Months			
	1-2	3-4	5-6	7-8	9-12	4	5	6	7-12
<b>Brace:</b> immobilizer for patient comfort	X	(X)							
<b>Range of motion minimum goals:</b>									
0°-110°	X								
0°-120°		X							
0°-135°			X						
<b>Weight bearing:</b>									
1/2 body weight	X								
Full		X							
<b>Patella mobilization</b>	X	X	X						
<b>Modalities:</b>									
Electrical muscle stimulation	X	X	X						
Pain/edema management (cryotherapy)	X	X	X	X	X	X	X	X	X
<b>Stretching:</b>									
Hamstring, gastroc-soleus, iliotibial band, quadriceps	X	X	X	X	X	X	X	X	X
<b>Strengthening:</b>									
Quadriceps isometrics, straight leg raises, active knee extension	X	X	X	X					
Closed-chain: gait retraining, toe raises, wall sits, mini-squats	X	X	X	X	X				
Knee flexion hamstring curls (90°)	X	X	X	X	X	X	X	X	X
Knee extension quadriceps (90°-30°)	X	X	X	X	X	X	X	X	X
Hip abduction-adduction, multi-hip	X	X	X	X	X	X	X	X	X
Leg press (70°-10°)	X	X	X	X	X	X	X	X	X
<b>Balance/proprioceptive training:</b>									
Weight-shifting, cup walking, BBS	X	X	X	X					
BBS, BAPS, perturbation training, balance board, mini-trampoline			X	X	X	X	X	X	
<b>Conditioning:</b>									
UBC	X	X	X						
Bike (stationary)		X	X	X	X	X	X	X	X
Aquatic program		X	X	X	X	X	X	X	X
Swimming (kicking)				X	X	X	X	X	X
Walking				X	X	X	X	X	X
Stair climbing machine			X	X	X	X	X	X	X
Ski machine			X	X	X	X	X	X	X
Elliptical machine			X	X	X	X	X	X	X
Running: straight					X	X	X	X	X
Cutting: lateral carioca, figure-8's						X	X	X	X
Plyometric training						X	X	X	X
Full sports							X	X	X

BAPS = Biomechanical Ankle Platform System (Camp, Jackson, MI), BBS = Bidex Balance System (Bidex Medical Systems, Inc, Shirley, NY), UBC = upper body cycle (Bidex 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 1. Weeks 1 to 2

<b>General Observation</b>	50% weight bearing with 2 crutches when: - Postoperative pain controlled - Hemarthrosis controlled - Voluntary quadriceps contraction achieved	
<b>Factors Evaluated</b>	Pain Hemarthrosis Patellar mobility Range of motion (minimum) Quadriceps contraction & patella migration Soft tissue contracture Joint arthrometer (day 14)	<b>Goals</b> Controlled Mild Good 0°-110° Good None < 3 mm
<b>Frequency</b> 3-4 x/day 10 minutes	<b>Range of motion</b> Range of motion passive, 0°-90° Patella mobilization Ankle pumps (plantar flexion with resistance band) Hamstring, gastroc-soleus stretches	<b>Duration</b> 5 reps x 30 secs
3 x/day 15 minutes	<b>Strengthening</b> Straight leg raises (flexion, extension, abduction, adduction) Active quadriceps isometrics (full extension) Knee flexion (active, 0°-90°) Knee extension (active-assisted, 90°-30°) Multi-hip machine (flexion, extension, abduction, adduction) Leg press (70°-10°) Closed-chain - Mini-squats (0°-45°, 1/2 weight bearing)	3 sets x 10 reps 1 set x 10 reps 3 sets x 20 reps
3 x/day 5 minutes	<b>Balance training</b> Weight shift side/side and forward/back	5 sets x 10 reps
1-2 x/day 5 minutes	<b>Aerobic conditioning</b> UBC	
As required	<b>Modalities</b> Electrical muscle stimulation Cryotherapy	20 minutes 20 minutes
<b>Goals</b>	Range of motion 0°-110° Adequate quadriceps contraction Control inflammation, effusion 50% weight bearing	

## Phase 2. Weeks 3 to 4

<b>General Observation</b>	Full weight bearing with 1 crutch when: - Pain controlled without narcotics - ROM 0°-100°	- Effusion controlled - Muscle control throughout ROM	
<b>Evaluation</b>	Pain Effusion Patellar mobility Range of motion minimum Muscle control Joint arthrometer (day 28) Inflammatory response	Mild Minimal Good 0°-120° 3/5 < 3 mm None	<b>Goals</b>
<b>Frequency</b> 3-4 x/day 10 minutes	<b>Range of motion</b> Range of motion passive, 0°-120° Patella mobilization Ankle pumps (plantar flexion with resistance band) Hamstring, gastroc-soleus stretches		<b>Duration</b> 5 reps x 30 secs
2-3 x/day 20 minutes	<b>Strengthening</b> Straight leg raises (flexion, extension, abduction, adduction) Isometric training: multi-angle (90°, 60°, 30°) Heel raise/toe raise Hamstring curls (active, 0°-90°) Knee extension (active, 90°-30°) Closed-chain - Wall sits - Mini-squats Multi-hip machine (flexion, extension, abduction, adduction) Leg press (70°-10°)	3 sets x 10 reps 1 set x 10 reps 3 sets x 10 reps 3 sets x 10 reps 3 sets x 10 reps 5 reps 3 sets x 20 reps 3 sets x 10 reps 3 sets x 10 reps	
3 x/day 5 minutes	<b>Balance training</b> Weight shift side/side and forward/back Balance board/2 legged	5 sets x 10 reps	
1-2 x/day 5 minutes	Cup walking Single leg stance (level surface)	5 reps	
2 x/day 5 minutes	<b>Aerobic conditioning</b> UBC Water walking Stationary bicycling (patellofemoral precautions)		
As required	<b>Modalities</b> Electrical muscle stimulation Cryotherapy	20 minutes 20 minutes	
<b>Goals</b>	Range of motion 0°-125° Muscle control Arthrometer within 3 mm Control inflammation, effusion 100% weight bearing		

## Phase 3. Weeks 5 to 6

<b>General Observation</b>	Independent ambulation when: - Pain controlled - ROM 0°-120°	- Effusion controlled - Muscle control throughout ROM	
<b>Evaluation</b>	Pain Effusion Patellar mobility ROM Muscle control Inflammatory response Gait		<b>Goals</b> No RSD Minimal Good 0°-135° 4/5 None Symmetrical
<b>Frequency</b> 3 x/day 10 minutes	<b>Range of motion</b> Range of motion passive, 0°-135° Patella mobilization Hamstring, gastroc-soleus stretches		<b>Duration</b> 5 reps x 30 secs
2 x/day 20 minutes	<b>Strengthening</b> Straight leg raises (ankle weight, not to exceed 10% of 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°-30°) Closed-chain - Wall sits - Mini-squats Multi-hip machine (flexion, extension, abduction, adduction) Leg press (70°-10°)		3 sets x 10 reps 3 sets x 10 reps 2 sets x 10 reps 3 sets x 20 reps 3 sets x 10 reps 3 sets x 10 reps 5 reps 3 sets x 20 reps 3 sets x 10 reps 3 sets x 10 reps
3 x/day 5 minutes	<b>Balance training</b> Balance board/2 legged Lateral step-ups: 2-4"		
2 x/day 10 minutes	<b>Aerobic conditioning</b> (patellofemoral precautions) UBC Stationary bicycling Water walking Stair machine (low resistance, low stroke) Ski machine (short stride, level, low resistance) Elliptical (low resistance)		
As required	<b>Modalities</b> Cryotherapy		20 minutes
<b>Goals</b>	Range of motion 0°-135° Control inflammation, effusion Muscle endurance Recognition complications (motion loss, pain syndrome, increased AP displacement) Recognition patellofemoral changes Full weight bearing, normal gait		

## Phase 4. Weeks 7 to 8

<b>General Observation</b>	No effusion, painless ROM, joint stability Performs activities of daily living, can walk 20 minutes without pain	ROM 0°-135° Full weight bearing	
<b>Evaluation</b>	<ul style="list-style-type: none"> <li>■ Manual muscle test Hamstrings, quadriceps, hip abductors/adductors/flexors/extensors</li> <li>■ Swelling</li> <li>■ Joint arthrometer (8 weeks)</li> <li>■ Patellar mobility</li> <li>■ Crepitus</li> </ul>	<b>Goals</b> 4/5 None < 3 mm Good None/slight	
<b>Frequency</b> 2 x/day 10 minutes	<b>Range of motion</b> Hamstring, gastroc-soleus stretches	<b>Duration</b> 5 reps x 30 secs	
2 x/day 20 minutes	<b>Strengthening</b> Straight leg raises, rubber tubing Hamstring curls (active, 0°-90°) Knee extension with resistance (90°-30°) Leg press (70°-10°) Multi-hip machine (flexion, extension, abduction, adduction) Closed-chain <ul style="list-style-type: none"> <li>- Wall sits</li> <li>- Mini-squats</li> </ul>	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 5 reps 3 sets x 20 reps	
3 x/day 5 minutes	<b>Balance training</b> Balance board/2 legged Single leg stance Resistance band walking Plyoback ball toss Perturbation training		
1-2 x/day 15-20 minutes	<b>Aerobic conditioning</b> (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)		
As required	<b>Modalities</b> Cryotherapy	20 minutes	
<b>Goals</b>	Increase strength and endurance		

## Phase 5. Weeks 9 to 12

<b>General Observation</b>	No effusion, painless ROM, joint stability Performs activities of daily living, can walk 20 minutes without pain	ROM 0°-135° Full weight bearing	
<b>Evaluation</b>	<ul style="list-style-type: none"> <li>■ Manual muscle test Hamstrings, quadriceps, hip abductors/adductors/flexors/extensors</li> <li>■ Isometric test (12 wks, mean avg torque/% deficit quads &amp; hams)</li> <li>■ Swelling</li> <li>■ Joint arthrometer (12 weeks)</li> <li>■ Patellar mobility</li> <li>■ Crepitus</li> </ul>	<b>Goals</b> 4/5 30 None < 3 mm Good None/slight	
<b>Frequency</b> 2 x/day 10 minutes	<b>Range of motion</b> Hamstring, gastroc-soleus, quad, ITB stretches	<b>Duration</b> 5 reps x 30 secs	
2 x/day 20 minutes	<b>Strengthening</b> Straight leg raises, rubber tubing Hamstring curls (active, 0°-90°) Knee extension with resistance (90°-30°) Leg press (70°-10°) Multi-hip machine (flexion, extension, abduction, adduction) Closed-chain <ul style="list-style-type: none"> <li>- Wall sits</li> <li>- Mini-squats</li> <li>- Lateral step-ups (2-4" block)</li> </ul>	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 5 reps 3 sets x 20 reps 3 sets x 10 reps	
3 x/day 5 minutes	<b>Balance training</b> Balance board/2 legged Single leg stance Resistance band walking Plyoback ball toss Perturbation training		
3 x/week 15 -20 minutes	<b>Aerobic conditioning</b> (patellofemoral precautions) Stationary bicycling Water walking Swimming (kicking) Walking Stair machine (low resistance, low stroke) Ski machine (short stride, level, low resistance) Elliptical machine (low resistance)		
3 x/week 10 minutes	<b>Running program</b> (straight) Jog Walk Backward walk	1/4 mile 1/8 mile 20 yards	
As required	<b>Modalities</b> Cryotherapy	20 minutes	
<b>Goals</b>	Increase strength and endurance		

## Phase 6. Weeks 13 to 26

<b>General Observation</b>	No effusion, painless ROM, joint stability Performs activities of daily living, can walk 20 minutes without pain	
<b>Evaluation</b>	Isokinetic test (isometric + torque 300°/sec, % difference quads & hams, tested monthly) Swelling Joint arthrometer Patellar mobility Crepitus Single-leg function tests (hop distance, timed hop, % inv/uninv)	<b>Goals</b> 20-25% None 3 mm Good None/slight 75%
<b>Frequency</b> 2 x/day 10 minutes	<b>Range of motion</b> Hamstring, gastroc-soleus, quad, ITB stretches	<b>Duration</b> 5 reps x 30 secs
1 x/day 20-30 minutes	<b>Strengthening (patellofemoral precautions)</b> Straight leg raises, rubber tubing (high speed) Hamstring curls (active, 0°-90°) Knee extension with resistance (90°-30°) 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	<b>Balance training</b> Balance board/2 legged → Single leg Single leg stance → Unstable platform	
3 x/week 20-30 minutes	<b>Aerobic conditioning (patellofemoral precautions)</b> Stationary bicycling Water walking Swimming (kicking) Walking Stair machine (low resistance, low stroke) Ski machine (short stride, level, low resistance) Elliptical machine (low resistance)	
3 x/week 15-20 minutes	<b>Running program (straight)</b> Jog (progression of speed: 1/2, 3/4, full) Walk Backward run	1/4 – 1 mile 1/8 mile 20 yards
3 x/week	<b>Cutting program</b> – lateral, carioca, figure 8's	20 yards
3 x/week	<b>Functional training</b> Plyometric training: box hops, level, double-leg Sport specific drills	15 secs, 4-6 sets
As required	<b>Modalities</b> Cryotherapy	20 minutes
<b>Goals</b>	Increase strength and endurance	

## Phase 7. Weeks 27 to 52

<b>General Observation</b>	No effusion, painless ROM, joint stability Performs ADL, can walk 20 minutes without pain	
<b>Evaluation</b>	Isokinetic test (torque at 180°/sec & 300°/sec, % difference quads & hams, tested quarterly; isometric if symptomatic PF joint Swelling Joint arthrometer Patellar mobility Crepitus Single-leg function test (hop distance, timed hop, % inv/uninv)	<b>Goals</b> 10-15 None < 3 mm Good None/slight 85
<b>Frequency</b> 2 x/day 10 minutes	<b>Range of motion</b> Hamstring, gastroc-soleus, quad, ITB stretches	<b>Duration</b> 5 reps x 30 secs
3-4 x/week 20-30 minutes	<b>Strengthening (patellofemoral precautions)</b> Straight leg raises, rubber tubing (high speed) Hamstring curls (active, 0°-90°) Knee extension with resistance (90°-30°) Leg press (70°-10°) Multi-hip machine (flexion, extension, abduction, adduction)	3 sets x 30 reps
3 x/day 5 minutes	<b>Balance training</b> Balance board/2 legged → Single leg Single leg stance - unstable platform w/secondary activity	1-2 sets x 8-12 reps
3 x/week 20-30 minutes	<b>Aerobic conditioning</b> (patellofemoral precautions) Stationary bicycling Water walking Swimming (kicking) Walking Stair machine (low resistance, low stroke) Ski machine (short stride, level, low resistance) Elliptical (low resistance)	
3 x/week 20 minutes	<b>Running program</b> (straight) Interval training (20, 40, 60, 100 yards) Walk/rest phase (3:1 rest: work) Backward run	20 yards
3 x/week	<b>Cutting program</b> – lateral, carioca, figure 8's	20 yards
3 x/week	<b>Functional training</b> Plyometric training: box hops, level, double-leg Sport specific drills	15 secs, 4-6 sets
As required	<b>Modalities</b> Cryotherapy	20 minutes
<b>Goals</b>	Increase function, strength, endurance Return to previous activity level	

## SPORTSMETRICS JUMP TRAINING

SportsMetrics is the first ACL Injury Prevention Program that is scientifically proven. It was created by a team of athletic trainers, physical therapists and researchers, under the direction of Dr. Frank Noyes. Sportsmetrics™ is the foundation upon which sports-specific skills are built. Jumping drills are used to teach the athlete to preposition the entire body safely when accelerating (jumping) or decelerating (landing). A solid foundation of strength, coordination and overall physical conditioning is required for athletes to attain their highest potential in their sport-specific skills.

### JUMP DESCRIPTIONS

#### 180 JUMPS

Two-footed jump, rotating 180° in mid-air. Keep arms At the side in a 90° angle. Hold each landing for 2 sec. Repeat in reverse direction

#### BOUNDING FOR DISTANCE

Start bounding in place and slowly increase distance with each step, keeping knees high.

#### BOUNDING IN PLACE

While leaning forward over the toes, jump from one leg to the other straight up and down, progressively increasing rhythm and knee height.

#### BROAD JUMP-STICK LANDING

Two-footed jump as far as possible. Hold landing (knees bent) for 5 seconds.

#### CONE JUMPS

With feet together, jump side-to-side over cones quickly. Then perform jumps forward and backward. (♦)

#### HOP,HOP, STICK

Perform three single leg hops, holding the third landing for 5 seconds with knees slightly bent. Increase distance of hop as technique improves. Alternate legs. (♦)

#### JUMP INTO BOUNDING

Two-footed broad jump. Land on single leg, then progress into bounding for distance. (♦)

#### SCISSORS JUMP

Start in stride position with one foot well in front of the other. Jump up, alternating foot positions in mid-air.

#### SINGLE LEG JUMPS FOR DISTANCE

One-legged hop for distance. Hold landing for 2 seconds with knee slightly bent. (♦)

#### SQUAT JUMPS (FROG JUMPS)

Standing jump raising both arms overhead, land in squatting position touching both hands to the floor. (♦)

#### STEP,JUMP UP,DOWN, VERTICAL

Two-footed jump onto a 6 to 8 inch box or stacked gym mats. Reverse and jump forward off box with two feet. After landing, quickly jump straight up with arms raised overhead.

#### TUCK JUMPS

From standing position, jump and bring both knees up to chest as high as possible. Repeat quickly. (♦)

#### WALL JUMPS (ANKLE BOUNCES)

With knees slightly bent and arms raised overhead, bounce up and down off toes.

#### JUMP,JUMP,JUMP, VERTICAL

Three broad jumps with vertical jump immediately after landing the third broad jump. Raise arms straight up with vertical jump.

### **IMPORTANT INFORMATION:**

- ⇒ (♦) These jumps performed on a surface such as a track or gym mats.
- ⇒ Proper form is a must!
- ⇒ Stop when the athlete loses proper form or fatigue has set in.
- ⇒ Rest time is double the jump time. 30 sec rest for rep jumps.

## SPORTSMETRICS JUMP TRAINING

**Warm-up:**

- 2 laps of jogging/skipping
- 2 laps of side shuffle
- Stretch for 5 to 10 minutes

**Cool-down:**

- Walk or light jog
- Stretch for 5 to 10 minutes
- Ice (if needed) for 15-20 minutes

**PHASE 1: TECHNIQUE DEVELOPMENT**

	WEEK 1			WEEK 2				
	TIME	MON	WED	FRI	TIME	MON	WED	FRI
Wall Jumps	20 sec	_____	_____	_____	25 sec	_____	_____	_____
Tuck Jumps	20 sec	_____	_____	_____	25 sec	_____	_____	_____
Broad jumps-stick landing	5 reps	_____	_____	_____	10 reps	_____	_____	_____
Squat Jumps	10 sec	_____	_____	_____	15 sec	_____	_____	_____
Cone Jumps								
Side-to-side	20 sec	_____	_____	_____	25 sec	_____	_____	_____
Back-to-front	20 sec	_____	_____	_____	25 sec	_____	_____	_____
180 Jumps	20 sec	_____	_____	_____	25 sec	_____	_____	_____
Bounding in Place	20 sec	_____	_____	_____	25 sec	_____	_____	_____
Total Contacts								
<b>Maximum goal per day of total contacts = 120 contacts</b>				<b>Maximum goal per day of total contacts = 150 contacts</b>				

**PHASE 2: FUNDAMENTALS**

	WEEK 3			WEEK 4				
	TIME	MON	WED	FRI	TIME	MON	WED	FRI
Wall Jumps	30 sec	_____	_____	_____	30 sec	_____	_____	_____
Tuck Jumps	30 sec	_____	_____	_____	30 sec	_____	_____	_____
Jump,jump,jump,vert jump	5 reps	_____	_____	_____	8 reps	_____	_____	_____
Squat Jumps	20 sec	_____	_____	_____	20 sec	_____	_____	_____
Bounding for Distance	1 run	_____	_____	_____	2 runs	_____	_____	_____
Cone Jumps								
Side-to-side	30 sec	_____	_____	_____	30 sec	_____	_____	_____
Back-to-front	30 sec	_____	_____	_____	30 sec	_____	_____	_____
Scissors Jump	30 sec	_____	_____	_____	5 reps	_____	_____	_____
Hop, hop, stick (double)	5 reps	_____	_____	_____				
Total Contacts								
<b>Maximum goal per day of total contacts = 160 contacts</b>				<b>Maximum goal per day of total contacts = 190 contacts</b>				

**PHASE 3: PERFORMANCE**

	WEEK 5			WEEK 6				
	TIME	MON	WED	FRI	TIME	MON	WED	FRI
Wall Jumps	30 sec	_____	_____	_____	30 sec	_____	_____	_____
Step,jump up,down,vertical	5 reps	_____	_____	_____	10 reps	_____	_____	_____
Scissors Jump	30 sec	_____	_____	_____	30 sec	_____	_____	_____
Single leg jumps distance	5 reps/leg	_____	_____	_____	5 reps/leg	_____	_____	_____
Squat Jumps	25 sec	_____	_____	_____	25 sec	_____	_____	_____
Jump into bounding	3 runs	_____	_____	_____	4 runs	_____	_____	_____
Single leg hop,hop stick	5 reps/leg	_____	_____	_____	5 reps/leg	_____	_____	_____
Total Contacts								
<b>Maximum goal per day of total contacts = 220 contacts</b>				<b>Maximum goal per day of total contacts = 250 contacts</b>				