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ACCELERATED REHABILIATION 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).

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	Postoperative Weeks					Postoperative Months			
	1-2	3-4	5-6	7-8	9-12	4	5	6	7-12
Brace: immobilizer for patient comfort	X	(X)							
Range of motion minimum goals:									
0°-110°	X								
0°-120°		X							
0°-135°			X						
Weight bearing:									
1/2 body weight	X								
Full		X							
Patella mobilization	X	X	X						
Modalities:									
Electrical muscle stimulation	X	X	X						
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:									
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
Balance/proprioceptive training:									
Weight-shifting, cup walking, BBS	X	X	X	X					
BBS, BAPS, perturbation training, balance board, mini-trampoline				X	X	X	X	X	
Conditioning:									
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
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 = 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 1. Weeks 1 to 2

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

Phase 2. Weeks 3 to 4

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

Phase 3. Weeks 5 to 6

General Observation	Independent ambulation when: - Pain controlled - Effusion controlled - ROM 0°-120° - Muscle control throughout ROM	
Evaluation		**Goals**
	Pain	No RSD
	Effusion	Minimal
	Patellar mobility	Good
	ROM	0°-135°
	Muscle control	4/5
	Inflammatory response	None
	Gait	Symmetrical
Frequency		**Duration**
3 x/day	**Range of motion**	
10 minutes	Range of motion passive, 0°-135°	
	Patella mobilization	
	Hamstring, gastroc-soleus stretches	5 reps x 30 secs
2 x/day	**Strengthening**	
20 minutes	Straight leg raises (ankle weight, not to exceed 10% of body weight)	3 sets x 10 reps
	Straight leg raises, rubber tubing	3 sets x 10 reps
	Isometric training: multi-angle (90°, 60°, 30°)	2 sets x 10 reps
	Heel raise/toe raise	3 sets x 20 reps
	Hamstring curls (active, 0°-90°)	3 sets x 10 reps
	Knee extension with resistance (90°-30°)	3 sets x 10 reps
	Closed-chain	
	- Wall sits	5 reps
	- Mini-squats	3 sets x 20 reps
	Multi-hip machine (flexion, extension, abduction, adduction)	3 sets x 10 reps
	Leg press (70°-10°)	3 sets x 10 reps
3 x/day	**Balance training**	
5 minutes	Balance board/2 legged	
	Lateral step-ups: 2-4”	
2 x/day	**Aerobic conditioning** (patellofemoral precautions)	
10 minutes	UBC	
	Stationary bicycling	
	Water walking	
	Stair machine (low resistance, low stroke)	
	Ski machine (short stride, level, low resistance)	
	Elliptical (low resistance)	
As required	**Modalities**	
	Cryotherapy	20 minutes
Goals	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

General Observation	No effusion, painless ROM, joint stability ROM 0°-135° Performs activities of daily living, Full weight can walk 20 minutes without pain bearing	
Evaluation		**Goals**
	■ Manual muscle test Hamstrings, quadriceps, hip abductors/adductors/flexors/extensors	4/5
	■ Swelling	None
	■ Joint arthrometer (8 weeks)	< 3 mm
	■ Patellar mobility	Good
	■ Crepitus	None/slight
Frequency		**Duration**
2 x/day 10 minutes	**Range of motion** Hamstring, gastroc-soleus stretches	 5 reps x 30 secs
2 x/day 20 minutes	**Strengthening** 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 - Wall sits - Mini-squats	 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	**Balance training** Balance board/2 legged Single leg stance Resistance band walking Plyoback ball toss Perturbation trarining	
1-2 x/day 15-20 minutes	**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)	
As required	**Modalities** Cryotherapy	20 minutes
Goals	Increase strength and endurance	

Phase 5. Weeks 9 to 12

General Observation	No effusion, painless ROM, joint stability ROM 0°-135° Performs activities of daily living, Full weight can walk 20 minutes without pain bearing	
Evaluation		**Goals**
	■ Manual muscle test Hamstrings, quadriceps, hip abductors/adductors/flexors/extensors	4/5
	■ Isometric test (12 wks, mean avg torque/% deficit quads & hams)	30
	■ Swelling	None
	■ Joint arthrometer (12 weeks)	< 3 mm
	■ Patellar mobility	Good
	■ Crepitus	None/slight
Frequency		**Duration**
2 x/day 10 minutes	**Range of motion** Hamstring, gastroc-soleus, quad, ITB stretches	 5 reps x 30 secs
2 x/day 20 minutes	**Strengthening** 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 - Wall sits - Mini-squats - Lateral step-ups (2-4" block)	 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	**Balance training** Balance board/2 legged Single leg stance Resistance band walking Plyoback ball toss Perturbation trarining	
3 x/week 15 -20 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) Elliptical machine (low resistance)	
3 x/week 10 minutes	**Running program** (straight) Jog Walk Backward walk	 1/4 mile 1/8 mile 20 yards
As required	**Modalities** Cryotherapy	 20 minutes
Goals	Increase strength and endurance	

Phase 6. Weeks 13 to 26

General Observation	No effusion, painless ROM, joint stability Performs activities of daily living, can walk 20 minutes without pain	
Evaluation		**Goals**
	Isokinetic test (isometric + torque 300°/sec, % difference quads & hams, tested monthly)	20-25%
	Swelling	None
	Joint arthrometer	3 mm
	Patellar mobility	Good
	Crepitus	None/slight
	Single-leg function tests (hop distance, timed hop, % inv/uninv)	75%
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 (patellofemoral precautions)** 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	**Balance training** Balance board/2 legged → Single leg Single leg stance → Unstable platform	
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) Elliptical machine (low resistance)	
3 x/week 15-20 minutes	**Running program** (straight) Jog (progression of speed: ½, ¾, full) Walk Backward run	 1/4 – 1 mile 1/8 mile 20 yards
3 x/week	**Cutting program** – lateral, carioca, figure 8's	20 yards
3 x/week	**Functional training** Plyometric training: box hops, level, double-leg Sport specific drills	 15 secs, 4-6 sets
As required	**Modalities** Cryotherapy	 20 minutes
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		**Goals**
	Isokinetic test (torque at 180°/sec & 300°/sec, % difference quads & hams, tested quarterly; isometric if symptomatic PF joint	10-15
	Swelling	None
	Joint arthrometer	< 3 mm
	Patellar mobility	Good
	Crepitus	None/slight
	Single-leg function test (hop distance, timed hop, % inv/uninv)	85
Frequency		**Duration**
2 x/day 10 minutes	**Range of motion** Hamstring, gastroc-soleus, quad, ITB stretches	 5 reps x 30 secs
3-4 x/week 20-30 minutes	**Strengthening (patellofemoral precautions)** 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 } 1-2 sets x 8-12 reps
3 x/day 5 minutes	**Balance training** Balance board/2 legged ⟶ Single leg Single leg stance - unstable platform w/secondary activity	
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) Elliptical (low resistance)	
3 x/week 20 minutes	**Running program** (straight) Interval training (20, 40, 60, 100 yards) Walk/rest phase (3:1 rest: work) Backward run	 20 yards
3 x/week	**Cutting program** – lateral, carioca, figure 8's	20 yards
3 x/week	**Functional training** Plyometric training: box hops, level, double-leg Sport specific drills	 15 secs, 4-6 sets
As required	**Modalities** Cryotherapy	 20 minutes
Goals	Increase function, strength, endurance Return to previous activity level	

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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

18O 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.

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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 # OF REPS				WEEK 2 # OF REPS		
	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		_____	_____	_____		_____	_____	_____
		Maximum goal per day of total contacts = 120 contacts				**Maximum goal per day of total contacts = 150 contacts**		

PHASE 2: FUNDAMENTALS

		WEEK 3 # OF REPS				WEEK 4 # OF REPS		
	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	_____	_____	_____	30 sec	_____	_____	_____
Hop, hop, stick (double)	5 reps	_____	_____	_____	5 reps	_____	_____	_____
Total Contacts		_____	_____	_____		_____	_____	_____
		Maximum goal per day of total contacts = 160 contacts				**Maximum goal per day of total contacts = 190 contacts**		

PHASE 3: PERFORMANCE

		WEEK 5 # OF REPS				WEEK 6 # OF REPS		
	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		_____	_____	_____		_____	_____	_____
		Maximum goal per day of total contacts = 220 contacts				**Maximum goal per day of total contacts = 250 contacts**		