

Posterior Cruciate Ligament Reconstruction

Quincy Medical Center

Massachusetts General Hospital

Eric Berkson, MD

Orthopaedic Surgery of Quincy
909 Hancock Street
Quincy MA
(617) 773-7457

This protocol is a guideline for your rehabilitation after posterior cruciate ligament reconstruction. You may vary in your ability to do these exercises and to progress from one phase to the other. Please call Dr. Berkson if you are having a problem with your knee or if you need clarification of these instructions.

PHASE I: 0 - 2 week after surgery

You will go home with a knee brace, crutches, cryocuff cold therapy unit and a CPM machine.

GOALS

1. Protect the reconstruction - avoid falling
2. Ensure wound healing
3. Attain and maintain full knee extension
4. Gain knee flexion (knee bending) to 90 degrees
5. Decrease knee and leg swelling
6. Promote quadriceps muscle strength
7. Avoid blood pooling in the leg veins

ACTIVITIES

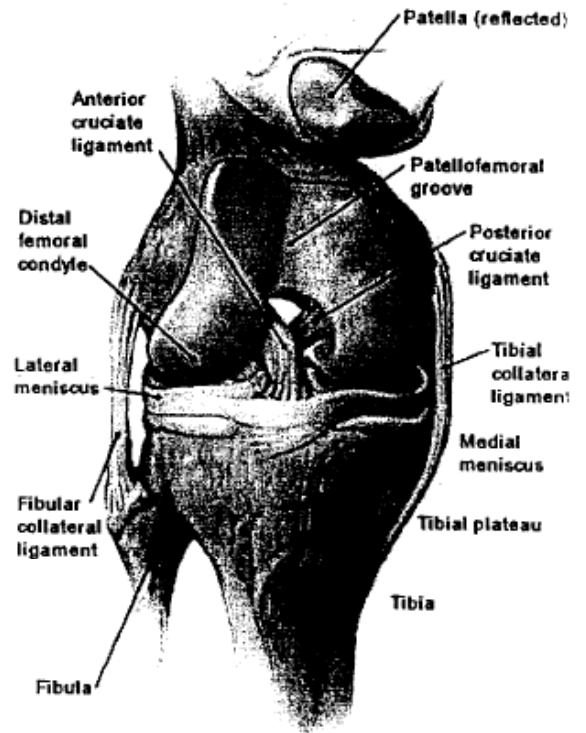
1. CONTINUOUS PASSIVE MOTION (CPM)

Use the CPM machine at home as much as possible. You should use the machine at least 10 hours per day. You may move the machine to a sofa, the floor or onto a bed as you change positions and locations. You should use the machine at night while sleeping; slow down the machine at night to facilitate sleeping. Extension (knee straight) on the machine should be set at minus five degrees at all times to help your knee extend.

It is very important that you straighten the knee completely! The machine should be programmed to include an extension pause of 5 seconds (in other words, when the knee is straightened out, it pauses in the straight position to allow you to stretch it out straight). This flexion setting will start at around 30 - 40 degrees and should be gradually increased to 90 degrees as you can tolerate more bending of your knee.

2. BRACE/CRUTCHES

The brace should be set locked with the knee fully straight for the first 2 weeks after surgery. After you follow -up with Dr. Berkson, your knee brace will be set to allow your knee to bend and straighten. Use the brace when walking when walking. Remove the brace for CPM and exercises.



BRACE/CRUTCHES continued

You will be asked use crutches to walk after surgery. You will be instructed in partial weight bearing with the crutches for at least the first 6 weeks after surgery. Dr. Berkson will give special instructions in some cases.

3. CRYOCUFF (COLD APPLICATION)

If you are experiencing pain, swelling, or discomfort, we suggest icing for 15-20 minutes with at least a 60-minute break in between. Use your cryocuff or place ice in a zip lock bag and/or in a towel and apply to the injured area. Never place ice directly on the skin.

4. WOUND CARE

Remove your bandage on the second morning after surgery but leave the small pieces of white tape (steri strips) across the incision. You can wrap an elastic bandage (ace) around the knee at other times to control swelling. You may now shower and get your incision wet, but do not soak the incision in a bathtub or Jacuzzi until the stitches have been removed.

5. ASPIRIN / ELASTIC STOCKINGS

Take an aspirin each morning, wear an elastic stocking (TED) below the knee for 2 weeks, and do at least 10 ankle pump exercises each hour to help prevent phlebitis (blood clots in the veins).

6. FREE / MACHINE WEIGHTS

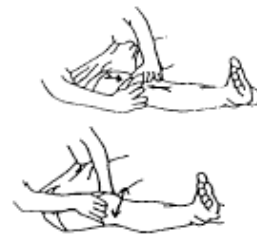
Upper Body/Trunk Only

We suggest that you do not use any lower extremity free or machine weights. If you are doing free or machine weights for the upper body and trunk, we suggest a very light resistance of 3 sets of 15-20 repetitions. Do not place yourself in a compromising position with your recently operated knee. Do not do exercises while standing. Use a bench or chair to support your body weight.

EXERCISE PROGRAM

The following exercises should be done 2 to 3 times a day.

Patellar Mobilization to prevent scar tissue from binding the kneecap. With the knee fully straightened, grasp the edges of your kneecap between your thumb and index finger. Move the kneecap side to side and up and down. Do for 3 to 5 minutes.



Quadriceps Setting

Lie on your back or sitting with the knee extended fully straight as in figure. Tighten and hold the front thigh muscle making the knee flat and straight. If done correctly, the kneecap will slide slightly upward toward the thigh muscle. The tightening action of the quadriceps should make your knee straighten and be pushed flat against the bed or floor. Hold 5 seconds for each contraction.

Do 20 repetitions three times a day.



Sitting Heel Slides - to regain the bend (flexion of the knee).

While sitting in a chair or over the edge of your bed, support the operated leg with the uninvolved leg. Lower the operated leg, with the unoperated leg controlling, allowing the knee to bend as far as you are comfortable. Hold five seconds and slowly relieve the stretch by lifting the foot upward, with the uninvolved leg, to the straight position (passive assist). Do 20 repetitions.

Straight Leg Lift

Tighten the quadriceps muscle so that the knee is flat, straight and fully extended. Try to raise the entire operated limb up off of the floor or bed. If you are able to keep the knee straight raise the limb to about 45 degrees, pause one second and then lower slowly to the bed. Relax and repeat. If the knee bends when you attempt to lift the limb off of the bed, do not do this exercise. Keep trying to do the quadriceps setting exercise until you can lift the limb without letting the knee bend. Do 20 repetitions.



Hip Abduction

Lie on your unoperated side. Keep the knees fully extended. Raise the operated limb upward to a 45-degree angle as illustrated. Hold one second, and then lower slowly. Do 20 repetitions.

Ankle Pumps - to stimulate circulation in the leg.

Move your foot in an up and down motion 30- 40 times a minute.



OFFICE VISIT

Please return to see Dr Berkson approximately two weeks after your surgery. At this time, your sutures will be removed and your progress will be checked. You will see the physical therapist for exercise instruction. You will discontinue CPM at this time.

Posterior Cruciate Ligament Reconstruction

Phase 2: 2-6 Weeks After Surgery

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Goals:

1. Protect the reconstruction, avoid falling
2. Ensure wound healing
3. Maintain full knee extension (straighten knee fully)
4. Begin quadriceps muscle strengthening
5. Attain knee flexion of 90 degrees or more
6. Decrease knee and leg swelling
7. Protected gait with crutches and partial weight bearing

ACTIVITIES

1. Cryocuff

Use the cryocuff or ice bags to decrease swelling for 20 minutes three times a day after each exercise session.

2. Brace / Crutches

Always wear the post-operative brace when walking (the brace should be set to allow full extension and 90 degrees of flexion). Always use your crutches and bear only partial weight on the operated leg. Follow these instructions until you return for your follow-up with Dr. Berkson at six weeks after surgery

3. Swelling

Continue using the elastic stockings (TED) for the lower leg and wrapping the knee with an elastic bandage (ACE) to control swelling.

4. Exercise Program

Stationary Bicycle

Utilize a stationary bicycle to move the knee joint and increase knee flexion. If you cannot pedal all the way around, then keep the foot of your operated leg on the pedal, and pedal back and forth until your knee will bend far enough to allow a full cycle. Use the non-operated ('good') leg to move the pedals while your operated (PCL) leg just travels around as a 'passenger'. Most people are able to achieve a full cycle revolution backwards first, followed by forward. You may ride the cycle with no resistance for up to 10-15 minutes, 1 to 2 times a day. Set the seat height so that when you are sitting on the bicycle seat, your knee is fully extended with the heel resting on the pedal in the fully bottom position. You should then actually ride the bicycle with your forefoot resting on the pedal.



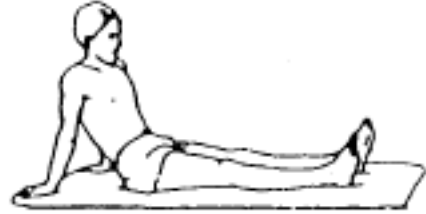
Range of Motion and Strengthening Exercises(brace oft)

Continue the exercises from phase 1.

The following exercises should be done for 20 repetitions each, 2 to 3 times a day.

Quadriceps Setting Exercise

Lie on your back with the knee extended fully straight as illustrated. Tighten (contract) and hold the front thigh muscle (quadriceps) making the knee flat and straight. If done correctly, the kneecap will slide slightly upward toward the thigh muscles. The tightening action of the quadriceps muscles should make your knee straighten and be pushed flat against the bed or floor. Hold five seconds for each contraction.



Standing Toe Raises

Stand facing a wall, hands on the wall for support and balance. Keep the knees extended fully. Tighten the quadriceps to hold the knee fully straight. Raise up on 'tip-toes' while maintaining the knees in full extension. Hold for one second, then lower slowly to the starting position.



Straight Leg Lift

Tighten the quadriceps muscle so that the knee is flat, straight and fully extended. Try to raise the entire operated limb up off the floor or bed. If you are able to keep the knee straight raise the limb to about 45 degrees, pause one second and then lower slowly to the bed. Relax and repeat. If the knee bends when you attempt to lift the limb off of the bed, do not do this exercise. Keep trying to do the quadriceps setting exercise until you can lift the limb without letting the knee bend.



Short Arc Lift

With the knee bent over a rolled up towel or blanket, lift the foot so that the knee fully straightens. Hold the knee locked in extension for five seconds, then slowly lower. Be sure that the bend in your knee is no greater than 30 degrees for this exercise (see illustration).



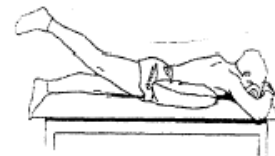
Hip Abduction

Lie on your unoperated side. Keep the knees fully extended. Raise the operated limb upward to a 45-degree angle as illustrated. Hold one second, then lower slowly.



Prone Hip Extension

Lie face down (prone). Keep the knee fully extended. Raise the operated limb backward as illustrated. Hold one second, then lower slowly.



OFFICE VISIT

Please arrange to see Dr. Berkson in four weeks (6 weeks after surgery).

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Phase 3: 6-12 Weeks Post Surgery

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Goals

1. Protect the reconstruction, avoid falling
2. Ensure wound healing
3. Maintain full knee extension (straighten knee fully)
4. Begin quadriceps muscle strengthening
5. Attain knee flexion of 90 degrees or more
6. Decrease knee and leg swelling
7. Return to normal walking without crutches

ACTIVITIES

1. Cryocuff

Use the cryocuff or ice bags as needed to decrease swelling for 20 minutes.

2. Brace / Crutches

You can discontinue use of the brace and crutches according to Dr. Berkson's instructions

3. Exercise Program

Stationary Bicycle

Utilize a stationary bicycle to move the knee joint and increase knee flexion. If you cannot pedal all the way around, then keep the foot of your operated leg on the pedal, and pedal back and forth until your knee will bend far enough to allow a full cycle. Most people are able to achieve a full cycle revolution backwards first, followed by forward. You can now ride the bike normally, using both legs actively. You may ride the cycle with mild resistance for up to 10-15 minutes, 1 to 2 times a day. Set the seat height so that when you are sitting on the bicycle seat, your knee is fully extended with the heel resting on the pedal in the fully bottom position. You should then actually ride the bicycle with your forefoot resting on the pedal.

Range of Motion and Strengthening Exercises (brace off)

The following exercise program should be followed as directed by Dr. Berkson or the physical therapist. For the straight leg raise, hip abduction and prone hip extension, if the exercise can be performed easily after the first week, then an ankle weight may be used to increase the resistance of the exercise and build strength. Start with 1 pound and add 1 pound per week until you reach 5 pounds. Do the exercises daily for the first week, and then decrease to every other day when using ankle weights. 3 sets of 10 repetitions is recommended for all exercises. You may ride the stationary bicycle daily for 20 to 30 minutes.

Wall Slides

Stand upright with your back and buttocks touching a wall. Place the feet about 12 inches apart and about 6 inches from the wall. Slowly lower your hips by bending the knees and slide down the wall until the knees are flexed about **60 degrees or less** (illustration). Pauses five seconds and then slowly slide back up to the upright starting position. Note: squatting or wall sliding deeper than 60 degrees at the knees will put excess strain on the healing PCL graft.



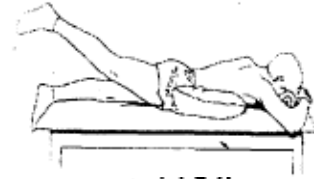
1/3 Knee bends

Stand facing a table or desk with the feet about 1 foot apart. Lean forward at the hips and bend the knees as if starting to sit down. Lower the hips about 5 or 6 inches (so that the knees are flexed about 30 degrees), pause 1 to 2 seconds and return to the full upright position



Prone Hip Extension

Lie face down (prone). Keep the knee fully extended. Raise the operated limb backward as illustrated. Hold one second, then lower slowly.



Hip Abduction

Lie on your unoperated side. Keep the knees fully extended. Raise the operated limb upward to a 45-degree angle as illustrated. Hold one second, then lower slowly.



Straight Leg Lift

Tighten the quadriceps muscle so that the knee is flat, straight and fully extended. Try to raise the entire operated limb up off of the floor or bed. If you are able to keep the knee straight raise the limb to about 45 degrees, pause one second and then lower slowly to the bed. Relax and repeat. If the knee bends when you attempt to lift the limb off of the bed, do not do this exercise. Keep trying to do the quadriceps setting exercise until you can lift the limb without letting the knee bend.

Standing Toe Raises

Stand facing a wall, hands on the wall for support and balance. Keep the knees extended fully. Tighten the quadriceps to hold the knee fully straight. Raise up on 'tip-toes' while maintaining the knees in full extension. Hold for one second, then lower slowly to the starting position.

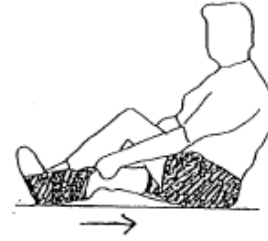
Short Arc Lift

With the knee bent over a rolled up towel or blanket, lift the foot so that the knee fully straightens. Hold the knee locked in extension for five seconds, then slowly lower. Be sure that the bend in your knee is no greater than 30 degrees for this exercise (see illustration).



Heel Slides

While lying on your back (figure), actively slide your heel backward to bend the knee. Keep bending the knee until you feel a stretch in the front of the knee. Hold this bent position for five seconds and then slowly relieve the stretch and straighten the knee. While the knee is straight, you may repeat the quadriceps setting exercise. Continue this exercise until you can fully bend your knee equal to the unoperated side. Also, as you start to gain flexion, you can assist your efforts to gain flexion by assisting the heel slide with a towel. See illustration. Repeat 20 times, three times a day.



OFFICE VISIT

Please arrange to see Dr. Berkson in four weeks (12 weeks after surgery).

Posterior Cruciate Ligament Reconstruction

Phase 4: 12-18 Weeks After Surgery

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Goals:

1. Protect the reconstruction; avoid falling.
2. Maintain full knee extension.
3. Attain full knee flexion.
4. Walk with a normal heel-toe gait with no limp.
5. Muscle strength and conditioning improvements.

1. Brace / Crutches

The brace and crutches are usually discontinued after you see Dr. Berkson at your 6-week postoperative office visit. Concentrate on walking with a heel-toe gait without a limp.

2. Cryocuff

Continue to use the cryocuff, as needed, for 20 minutes after each workout.

3. Knee Support

Buy an elastic knee sleeve (made of neoprene rubber) at a sporting goods store. It should have an opening for the kneecap and velcro straps but does not need hinges on the sides. Use this support if you are on your feet for a prolonged period of time.

4. Stationary Bicycle

Utilize a stationary bicycle to both strengthen the thigh muscles and increase knee flexion. If you cannot yet pedal all the way around, then keep the foot of your operated leg on the pedal, and pedal back and forth until your knee will bend far enough to allow a full cycle. You may ride the cycle with mild resistance for up to 20 minutes a day. Set the seat height so that when you are sitting on the bicycle seat, your knee is fully extended with the heel resting on the pedal in the fully bottom position. You should then actually ride the bicycle with your forefoot resting on the pedal.

5. Swimming

You may begin swimming at this time, if available, using only the flutter kick and doing the freestyle and backstroke. Do not swim breast-stroke, butterfly or side-stroke yet. Swimming with a kick-board is safe as long as the flutter-kick is used. You can swim up to 15 to 20 minutes, 3 to 4 times per week.

6. Exercises

Quadriceps setting exercises should continue for 20 repetitions, 3 times per day. Continue the exercises from Phase 2 as a warm-up to the Phase 3 exercises. You should add the following exercises, every other day, as instructed by the physical therapist:

CHAIR SQUAT

In the chair squat exercise, you lower your buttocks toward the chair until your knee reaches a 60 degree angle or less (illustration). Remember to keep your head over your feet and bend at the waist as you descend. After the first week, you may hold dumbbells while performing this exercise. Start with 3 to 5 pounds in each hand. You may add 2 to 3 pounds per week until you reach 10 pounds in each hand. Do 3 sets of 10 to 15 repetitions.



WALL SLIDES

Stand upright with your back and buttocks touching a wall. Place the feet about 12 inches apart and about 6 inches from the wall. Slowly lower your hips by bending the knees and slide down the wall until the knees are flexed about 60 degrees or less (illustration). Pause five seconds and then slowly slide back up to the upright starting position. Do 3 sets of 10 to 15 repetitions. Follow the dumbbell instructions outlined for the chair squat.



SINGLE LEG STRENGTHENING PROGRESSION

At this time, it is important to begin the development of single-leg strength. Begin to follow the "Progression for Single Leg Strengthening" included in this packet if you are able to do the exercises without pain. The instructions estimate a time period of 10 to 12 weeks for you to progress through the whole program. This time line will vary for different people and knees, depending upon the presence of other knee problems. Again, limit flexion of the knee to 60 degrees or less during these exercises.

STANDING HAMSTRING CURL

Stand facing the wall or use the wall for balance and support. While standing on the unoperated limb, bend the knee of the operated side and raise the heel toward the buttock until the knee is flexed to a 45 degree' angle. Hold this flexed position for one second. Slowly lower the foot back to the floor. Keep the thighs aligned as illustrated. At this time, do not use any resistance or weights to do this exercise.



STRAIGHT LEG LIFT

Continue with five pounds of ankle weight or build to 5 pounds

HIP ABDUCTION (SIDE LEG RAISE)

Continue with five pounds of ankle weight or build to 5 pounds

PRONE HIP EXTENSION

Continue with five pounds of ankle weight or build to 5 pounds

ONE-LEGGED TOE RAISES

Continue the toe-raises from phase 2, but now try to raise up and down slowly on just the operated side. Hold the unoperated foot off the floor and hold the wall or a chair or table for balance and support.



HAMSTRING STRETCH

Perform this stretch in the position illustrated. Bend slowly forward at the hips, keeping the knee fully extended until you feel gentle stretch in the back of your thigh and knee. Hold the stretch for 15 to 20 seconds and repeat 3 to 5 times.



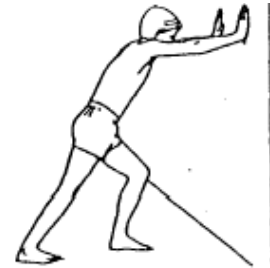
QUADRICEPS STRETCH

This stretch is performed in the position as illustrated. Lean gently backward as if bringing your heel toward the buttock. When a stretch is felt in the front of the thigh and knee, hold 15 to 20 seconds for 3 to 5 repetitions.



CALF STRETCH

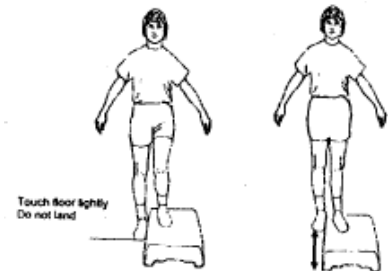
In the position illustrated, keep the heel flat on the floor and the knee fully extended. Lean forward at the hips with the arms supporting your weight. When you feel a gentle stretch in the back of your calf and knee, hold for 15 to 20 seconds for 3 to 5 repetitions.



Instructions for Single Leg Exercises

Step Up- Down Exercise

Place the foot of the operated limb on the stool. Maintain balance, if necessary, by holding onto the wall or chair (illustration). Standing sideways to the step, slowly step up onto the stool and slowly straighten the knee using the quadriceps muscles. Slowly lower the opposite foot to touch the floor. Do not land on the floor, just touch gently and repeat the step up.



Single Leg Wall Slide Exercise

Stand on the single leg with your back and buttocks touching a wall. Place the foot about 6 inches from the wall. Slowly lower your body by bending the knee and slide down the wall until the knee is flexed about 45 degrees (illustration). Pause five seconds and then slowly slide back up to the upright starting position. Keep the hips level and be sure you are using your knee muscles to perform the exercise.



Single Leg Squat Exercise

In the single leg squat exercise, you stand on the single leg and then lower your buttocks toward the chair. Slowly return to the standing and starting position. Remember to keep your head over your feet and bend at the waist as you descend. You do not have to squat all the way to the chair, instead, try to stay in a comfortable range of motion where there is no knee pain. As you gain strength, try to do the exercise without holding on to anything



Progression for Single Leg Strengthening

Step Up-Down exercise (12 to 18 weeks after surgery)

Start with a step of 3 inches in height

Start with 3 sets of 5 repetitions

Add one repetition per set, per workout, until you can do 3 sets of 10 (about 2 weeks)

If pain free, progress to a step of 6 inches in height

Repeat progression starting with 3 sets of 5 repetitions

Add one repetition per set until you can do 3 set of 10 (about 2 weeks)

If pain free, progress to a step of 9 inches in height (the height of a standard stair)

Repeat process of progression from 3 sets of 5, to 3sets of 10 (about 2 weeks)

At this point, you can begin to add the single leg wall slide exercise. The strength workouts should be practiced 3 times a week (every other day).

Single Leg Wall Slide (18 to 22 weeks after surgery)

Start with 3 sets of 5 repetitions

Add one repetition per set, per workout, until you can do 3 sets of 10 (about 2 weeks minimum)

At his point, you can begin to add the single leg squat exercise. The strength workouts should continue every other day at the most, with more time between workouts if the knee gets sore after a session. Continue doing the step-up exercise each workout. Alternate the workouts between the single leg wall slide and the single leg squat, e.g.,

Monday Single leg squat

Wednesday Single leg wall slides

Friday Single leg squat

Single Leg Squat (22 weeks after surgery onward)

Start with 3 sets of 5 repetitions

Add one repetition per set, per workout, until you can do 3 sets of 10 (about 2 weeks minimum).

After working up to the point where you can do 3 sets of ten of all three drills, you can hold dumbbells to add resistance. Start with 3 pounds in each hand and add I to 2 pounds a week until you reach 10 pounds in each hand.

As you get stronger and gain better control of you leg muscles, try not to hold onto anything for balance.

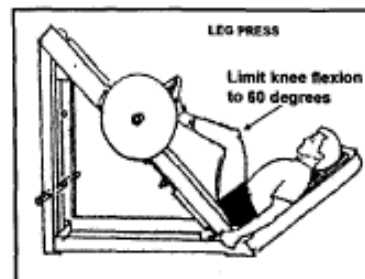
When you return to sports or recreational activities, decrease the strength workouts to 2 times a week and do I set of 10 of each of the three drills only, as a maintenance workout.

OPTIONAL ADDITIONAL EXERCISES

The following exercises may be added to your exercise program at 8 weeks after surgery:

LEG PRESS

When using a leg press machine, limit the flexion ofthe to 60 degrees or less to avoid over stressing the PCL graft. As the starting weight for these exercises, use an amount of weight that feels easy enough to perform 20 repetitions. Use this weight for the first week before raising the weight. The weight may be increased by about 5 pounds every 7 to 10 days thereafter, as long as you can perform 20 repetitions per set for 3 sets.



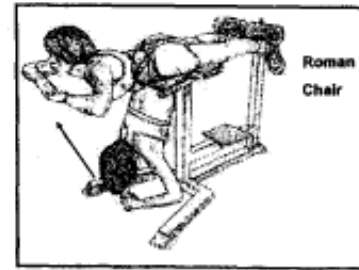
Weight Training

Leg Press

Hip Abductor/Adductor machine

Roman Chair

Calf Raise Machine



Precautions When Exercising

- When using a leg press machine, squatting or doing wall slides, limit the flexion of the knee to 60 degrees or less to avoid over stressing the PCL graft.
- When performing the standing hamstring curl, limit the bend in your knee to 45 degrees.
- Avoid pain at the surgical incision site
- Avoid pain and/or crepitus at the patella
- Build up resistance and repetitions gradually
- Perform exercises slowly avoiding quick direction change and impact loading
- Exercise frequency should be 2 to 3 times a week for strength building
- Be consistent and regular with the exercise schedule

Principles of Strength Training

- Warm-up prior to exercising by stationary cycling or other means
- You are "warmed -up" when you have started sweating
- Gently stretch all muscle groups next
- Do exercises involving multiple muscle groups first and individual muscle groups last .
- Do aerobic workouts after strength workouts
- Cool-down by stretching after finishing exercise

DO NOT do any of the following exercises:

1. Knee extension using a weight lifting machine
2. Resisted Hamstring curls or hamstring weight machine
3. Lunges
4. Stairmaster
5. Step exercises with impact
6. Running
7. Jumping
8. Pivoting or cutting

OFFICE VISIT

Please arrange to see Dr. Berkson in 3 MONTHS (24 weeks after surgery).

Posterior Cruciate Ligament Reconstruction

Phase 5: 18 Weeks After Surgery Onward

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Goals:

1. Regain full muscle strength.
2. Work on cardiovascular conditioning.
3. Do sports-specific training.

ACTIVITIES

Muscle-Strengthening Exercises

You should continue muscle-strengthening exercises from Phases 2 and 3 three times a week. You cannot decrease the number of repetitions per set from 15 to 10. This will allow you to work with heavier weights. Remember to do all exercises slowly with good form. Weights can be increased when you can do a particular weight easily for 3 sets of ten repetitions for 3 consecutive workouts.

Cardiovascular Conditioning

Use Nordic track, stationary bicycle, rowing machine or swimming workouts to build cardiovascular fitness. Three to five times per week for 20 to 30 minutes is sufficient for improvement in conditioning. Excessively long duration cardiovascular exercise can retard or delay muscular strength development. Strength improvement and gains in muscle size are your primary goals at this time.

Sports-Specific Training

To reach your ultimate goal of returning to sports participation, you must follow an orderly sequence of drills which are designed to re-train coordination that is necessary to provide the proper control of you knee. The following time-table gives an approximate sequence for returning to activities:

Activity	Months post-surgery
Golf	4 to 5
Running slowly	5
Tennis	6
Sprinting	6
Running quickly with slow starts and slow stops	6
Running with sprinting with fast starts and stops	7 to 8
Backward running	7 to 8
Zigzag running	7 to 8
Figure-of-eight running	7 to 8
Circle running	7 to 8
Carioca running	7 to 8
Hopping and jump training	8 to 9
Quickly pivoting and cutting	8 to 9
Full return to sports	9

Returning to Sports

You should discuss the timing of return to sports activities and brace use with Dr. Berkson.

Progressive Resistance Exercise (**PRE**) Principle

- To build muscle strength and size, the amount of resistance used must be gradually increased.
- The exercises should be specific to the target muscles
- The amount of resistance should be measurable and gradually increased over a longer period of time
- To avoid excess overload and injury, the weight or resistance must be gradually increased in increments of 5 to 10 %
- Resistance can be increased gradually every 10 to 14 days when following a regular and consistent program
- Adequate rest and muscle recovery between workout is necessary to maximize the benefit of the exercise
- If the PRE principle is followed too strictly, the weights potentially will go higher and higher.
- At a certain point, the joints and muscles will become overloaded and injury will occur.
- This eventuality can be avoided by refraining from using excessive weight during strength training.

Basic Knee Strengthening Program (Weeks 18 to 24 after surgery)

- Frequency: 2 to 3 Times per week
- Sets: 3
- Repetitions per set: 10- 15
- Emphasis is to build muscle strength using BOTH legs
- Progress according to the PRE principle

Basic Program Exercises- see illustrations at the back of the handout.

- Leg Press
- Standing Hamstring Curl (limit knee flexion to 45 degrees) add 1 lb. a week to reach 5 lb.
- Wall Slides (hold dumbbells for resistance)
- Roman Chair (strengthens hamstrings)
- Chair Squat (hold dumbbells for resistance)
- Calf Raises
- Hip Abductor/Adductor machine
- Step Up/Down (see attachment for progression)

If you do not have access to gym equipment, the following exercises can be substituted using ankle weights (see illustrations and instructions attached):

- Straight leg raise
- Short-arc lift
- Side lying abduction
- Standing hamstring curl
- Toe raises

In General, the Basic Knee Strengthening Program is good for most people who are active recreationally, but who do not participate in running and jumping sports. For people who will participate in running and jumping sports, the following Advanced Knee Strengthening Program can be used to develop a higher level of knee strength.

Advanced Knee Strengthening Program (Week 24 onward)

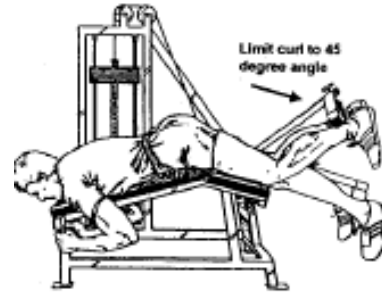
- Frequency: 2 to 3 Times per week
- Sets: 3
- Repetitions per set: 10
- Emphasis is to continue to build muscle strength using both legs and progress to Advanced Exercises using the Single leg.
- Advanced Single leg exercises are integrated with the exercises from the Basic Knee Strengthening Program (see attachment for progression of single leg drills).

The following single leg drills are integrated into the workout on a rotating basis:

Step Up/Down
Single Leg Wall Slide
Single Leg Squat

The Advanced Knee Strengthening Program would be as follows:

- Leg Press
- Hamstring Curl Machine (limit knee flexion to 45 degrees) Do not increase weight more than 1/2 plate per week
- Wall Slides
- Roman Chair
- Chair Squat
- Calf Raises
- Step up/down
- Alternate workouts with single leg wall slide and single leg squat
- When starting the new single leg drills, start with **3** sets of **5**, and add one repetition per set, per workout until you can do **3** sets of 10.
- When 3 sets of 10 are easy and pain free, then you can hold dumbbells to increase resistance and strength.



DO NOT do any of the following exercises:

1. Knee extension weight lifting machine
2. Running
3. Jumping or plyometrics
4. Pivoting or cutting
5. Lunges
6. Stairmaster
7. Step exercises with impact

Posterior Cruciate Ligament Reconstruction

Phase 6: Running Program for return to Sports

24 Weeks After Surgery Onward

Quincy Medical Center

Massachusetts General Hospital

Eric Berkson, MD

Orthopaedic Surgery of Quincy
909 Hancock Street
Quincy MA
(617) 773-7457

Goals:

1. Safely recondition the injured area for the demands of sports activity.
2. Provide a logical sequence of progressive drills for pre-sports conditioning
3. Provide objective criteria for safe return to sports.

Sports Specific Training

Phases of Training Straight-ahead running phase

Direction change running phase

Unrestricted direction change

Prerequisites Full Range of Motion

Strength at least 80 % of uninjured limb

Thigh girth within 1/2 inch of unaffected limb

Symmetrical muscle flexibility

Perform and pass functional tests

Functional Tests

Before starting the running sequence you must be able to:

1. Hop forward on both legs at least 2 feet
2. Hop to either side at least 1 foot
3. Hop up and down on both feet 10 times
4. Jog with no limp for 100 feet

Before starting unrestricted direction change you must be able to:

1. Hop forward on the affected limb for at least 80% of the distance of the unaffected side.
2. Hop to either side for 80% of the distance of the unaffected limb
3. Hop up and down on the operated limb 10 times with no pain

Warm-up and Stretch and Ice

Be careful to be sure that you warm-up well and stretch lightly before workouts, and stretch well again after workouts. Generally, you should do some walking, cycling or jogging so that you break a sweat before starting the running program. You should then stretch before beginning the running drills. Ice your knee for 20 minutes following workouts after stretching again as you are cooling down.

Criteria to progress

Do not progress to the next step in the progression until the present step is pain free, without swelling.

Frequency:

2 or 3 times per week. Repeats can be skipped if the running causes no problems.

Phase 1 Straight Ahead Running

DAY 1 Run 1/2 speed 100 yards, 10 repetitions

2 No Run

3 Repeat Day 1

4 Run 3/4 speed 100 yards, 10 repetitions

5 No Run

6 Repeat Day 4

7 No Run

8 Run 1/2 speed, 100 yards, 3 repetitions

Run 3/4 speed, 100 yards, 3 repetitions

Run full-speed, 50 yards, 4 repetitions

9 No Run

10-27 Continue workout from Day 8, adding one 50 yard run each workout until you can do (10) 50 yard full speed runs.

Phase 2 Basic Direction Change Running

DAY 28 Continue 100 yard run 1/2 speed, 2 repetitions; 3/4 speed, 2 repetitions; full speed, 2 repetitions

Start zig-zag run, round corners, 50 yards, 5 repetitions

29 No Run

30 Repeat Day 28

31 No Run

32 Repeat Day 28, add backward run 25 to gradual stop, then forward run 25 yards to gradual stop, 5 repetitions

33 No Run

34 Repeat Day 32

35 No Run

36 Repeat Day 32, add circle run, 20 foot or greater diameter circle, 3 repetitions to left and 3 reps to right.

37 No run

38 Repeat Day 36

39 No Run

40 Repeat Day 36, add figure of eight run, 20 foot or greater length, 5 repetitions

41 No Run

42 Carioca, 50 yards, 5 repetitions left, 5 repetitions right

Phase 3 Unrestricted Direction Change Running

Current workout:

100yd 1/2 speed, 3/4 speed and full speed each distance 2 repetitions

zig-zag run 5 repetitions

forward backward run 5 repetitions

circle run 6 repetitions

figure 8 runs 5 repetitions

carioca 5 repetitions each way

43 Continue Current Workout above and Add:

Shuttle run, 50 yards, direction change every 10 yards, 5 repetitions, alternate hands touching.

44 No run

45 Repeat Day 43

46 No Run

47 Repeat day 43

48 No run

49 Repeat day 43 and add Box drill, 20 yards square, 6 repetitions, alternate starting side.

50 No run

51 Repeat day 49

52 No run

53 Repeat day 49

54 No run

55 Repeat day 49 and add agility run, 5 repetitions, alternate starting side.

