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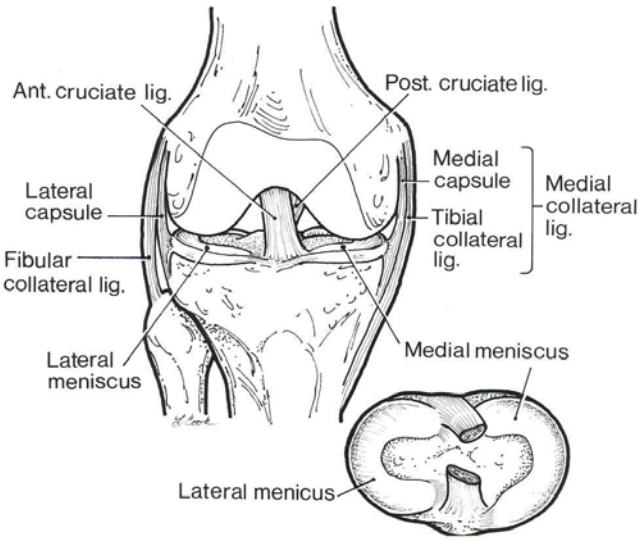
ANTERIOR CRUCIATE LIGAMENT INJURY

WHAT IS THE ANTERIOR CRUCIATE LIGAMENT?



The anterior cruciate ligament (ACL) is one of four major ligaments that stabilizes the knee joint. A ligament is a tough band of fibrous tissue, similar to a rope, which connects the bones together at a joint. There are two ligaments on the sides of the knee (collateral ligaments) that give stability to sideways motions: the medial collateral ligament (MCL) on the inner side and the lateral collateral ligament (LCL) on the outer side of the knee. Two ligaments cross each other (therefore, called "cruciate") in the center of the knee joint: The crossed ligament toward the front (anterior) is the ACL and the one toward the back of the knee (posterior) is the posterior cruciate ligament (PCL). The ACL prevents the lower bone (tibia) from sliding forward too much and stabilizes the knee to allow cutting, twisting and jumping sports. The PCL stops the tibia from moving backwards.

HOW CAN THE ACL TEAR?

The most common mechanism that tears the ACL is the combination of a sudden stopping motion on the leg while quickly twisting on the knee. This can happen in a sport such as basketball, for example, when a player lands on the leg when coming down from a rebound or is running down the court and makes an abrupt stop to pivot. In football, soccer, or lacrosse, the cleats on the shoes do not allow the foot to slip when excess force is applied. In skiing, the ACL is commonly injured when the skier sits back while falling. The modem ski boot is stiff, high, and is tilted forward. The boot thus holds the tibia forward and the weight of the body quickly shifts backwards. When excessive force is suddenly applied to the knee, the ACL gets injured.

Similarly, a contact injury, such as when the player is clipped in football, forces the knee into an abnormal position. This may tear the ACL, MCL and other structures.

WHAT ARE THE SIGNS THAT AN ACL IS TORN?

When the ACL tears, the person feels the knee go out of joint and often hears or feels a "pop". If he or she tries to stand on the leg, the knee may feel unstable and give out. The knee usually swells a great deal immediately (within two hours). Over the next several hours, pain often inecreases and it becomes difficult to walk.

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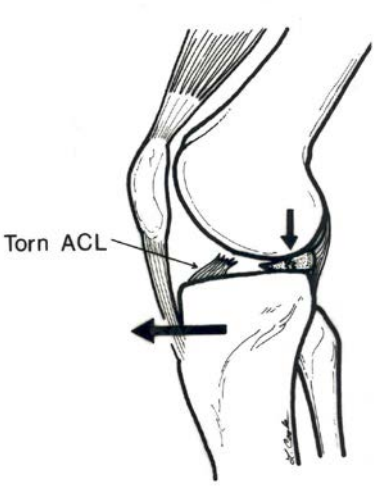
WHAT OTHER KNEE STRUCTURES CAN BE INJURED WHEN THE ACL TEARS?

The meniscus is a crescent shaped cartilage that acts as a shock absorber between the femur and tibia. Each knee has two menisci: medial (inner) and lateral (outer). The menisci are attached to the tibia. When the tibia suddenly moves forward and the ACL tears, the meniscus can become compressed between the femur and tibia resulting in a tear. The abnormal motion of the joint can also bruise the bones.



There is a second type of cartilage in the knee joint called articular cartilage. This is a smooth, white glistening surface that covers the ends of the bones. The articular cartilage provides lubrication and as a result, there is very little friction when the joint moves. This joint cartilage can get damaged when the ACL tears and the joint is compressed in an abnormal way. If this articular cartilage is injured, the joint no longer moves smoothly. Stiffness, pain, swelling and grinding can occur. Eventually, arthritis can develop.

The MCL and other ligaments in the joint can also be disrupted when the ACL tears. This is more common if an external blow to the knee causes the injury (such as if the knee was clipped while playing football, or when skiing).

WHAT IS THE INITIAL TREATMENT FOR A TORN ACL?

The initial treatment of the injured joint is to apply ice and gentle compression to control swelling. A knee brace and crutches are used. The knee should be evaluated by a doctor to see which ligaments are torn and to be sure other structures such as tendons, arteries, nerves, etc. have not been injured. X-rays are taken to rule out a fracture. Sometimes an MRI is needed, but usually the diagnosis can be made by physical examination.

HOW WILL THE KNEE FUNCTION IF THE ACL IS TORN?

If no structure other than the ACL is injured, the knee usually regains it range of motion and is painless after six or eight weeks. The knee will often feel “normal”. However, it can be a “trick knee”. If a knee does not have an ACL it can give way or be unstable when the person pivots or changes direction. The athlete can usually run straight ahead without a problem but when he or she makes a quick turning motion, the knee tends to give way and collapse. This abnormal motion can damage the menisci or articular cartilage and cause further knee problems.

If a person does not do sports and is relatively inactive, the knee can feel quite normal even if the ACL is torn. In young athletic patients, however, the knee will tend to reinjure frequently and

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give way during activities in which the person quickly changes direction. Therefore, it is usually recommended to reconstruct the torn ACL.

WHEN SHOULD SURGERY BE PERFORMED FOR A TORN ACL?

It is best to wait for the pain and swelling to subside and to allow associated injuries to heal before performing reconstructive surgery for the ACL. If surgery is done too soon after injury, rehabilitation is more difficult. In fact; the knee may get stiff and have permanent loss of motion. The athlete will usually get back to sports much more quickly if the knee is allowed to recover from the initial injury and to regain its full painless range of motion (usually about six weeks) before performing surgery.

In addition, regaining full motion prior to surgery allows an accelerated rehabilitation program to be used after surgery. With accelerated rehabilitation, continuous passive range of motion (CPM) is used for the first 2 weeks following surgery. The knee heals feels better more quickly, resulting in better initial joint function.

The best treatment following acute ACL injury is usually to protect the joint, apply ice and use crutches for several weeks. As the swelling and pain subside, and the patient can put weight on the leg; then the brace and crutches can be discontinued. The emphasis is on regaining knee motion. Resistive exercises to build up strength should not be done during this time to prevent damaging the knee cap and causing chondromalacia patella.

If the knee also has an injured medial collateral ligament (MCL), it is best to allow the MCL to heal completely (usually six to eight weeks) before reconstructing the ACL. The torn MCL usually does not need to be repaired surgically unless its healing is incomplete.

There may be instances when immediate surgery is indicated following injury. Examples are knee dislocations in which multiple ligaments are torn. Tears of the outer knee ligaments (lateral collateral ligament) often require timely surgical repair. Individual decisions need to be made on whether or not to reconstruct the ACL soon after injury in such instances where immediate surgery may be required.

DO ALL ACL TEARS NEED SURGERY?

No — some knees function reasonably well despite having a torn ACL. Good knee function without surgery is more common in older patients who are relatively inactive in sports. Patients who are younger, regardless of activity level, tend to have problems with instability and frequent episodes of giving way. Therefore, surgical reconstruction of a torn ACL is usually recommended for these patients.

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TREATMENT OPTIONS FOR A TORN ACL

I. NON-OPERATIVE

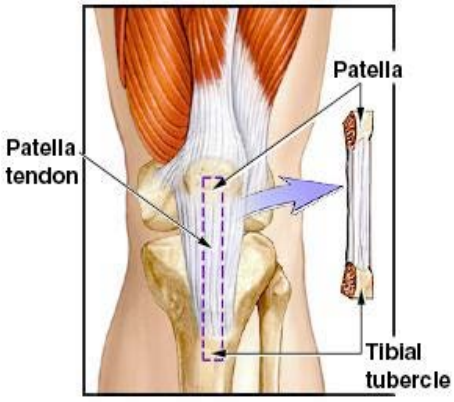
Some patients can function well even if the ACL is torn. However, it may be necessary to modify activities and avoid high-risk sports (such as basketball, soccer and football). The key to prevent the knee that has a torn ACL from giving out is to avoid quick pivoting motions. Wearing a knee brace can help to prevent re-injury. The main effect of a knee brace is to be a constant reminder to be careful.

However, a brace will not completely stabilize a knee that has a torn ACL. Exercises that restore the muscle strength, power, coordination, and endurance will also improve knee function and help stabilize the knee. However, a fully rehabilitated knee that has a torn ACL can still give way if a quick change in direction occurs.

II. LIMITED ARTHROSCOPIC SURGERY

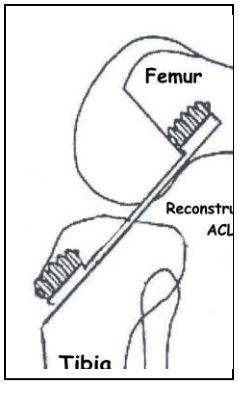
Many knees in which the ACL is torn have additional injuries such as torn menisci or fragments of articular cartilage that are displaced (creating a loose body and a defect in the articular cartilage). These associated injuries can cause symptoms of pain, swelling, and locking (in addition to symptoms of giving way due to the torn ACL). Arthroscopic surgery to remove torn menissci or to remove loose bodies can improve pain and eliminate locking. However, arthroscopy alone usually does not eliminate symptoms of instability, i.e. giving way.

III. ACL RECONSTRUCTION



Surgical reconstruction of a torn ACL involves replacing the torn ACL with soft tissue (called a “graft”, usually a tendon or ligament) from another part of the knee. The graft is then placed into a position to replace the function of the torn ACL. The most commonly used graft is taken from the middle third of the patellar tendon (the tendon connecting the knee cap to the tibial bone). Hamstring tendon grafts taken from the inner thigh on the back of the knee are also used. Occasionally, tendon grafts are taken from cadavers (referred to as “allograft”).

For most of these procedures, the operation is done arthroscopically instead of making long incisions. The knee is examined arthroscopically and associated injuries such as torn menisci, loose bodies, etc are treated. If the middle third of the patellar tendon is used, a small incision is made on the inner side of the leg just below the knee to take the graft (this results in numbness on the front of the knee). While viewing the inside of the joint through the arthroscope, guides are used to create bone tunnels in the exact positions to allow anatomic placement of the graft. The graft is then pulled into the bony tunnels. Absorbable screws are placed in the tunnels to wedge the bone graft against the wall of the tunnel to give immediate stability and allow healing of the bone graft.



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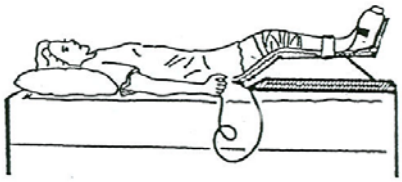
Postoperatively, an accelerated rehabilitation program allows the most rapid return of function. This necessitates using a continuous passive motion (CPM) machine for at least 10 hours per day for the first week following surgery. The patient can get up whenever he or she wishes for short periods of time using crutches and a knee brace.



The CPM is typically arranged by Dr. Gill's office. It is a small device that sits on the bed and very slowly moves the knee continuously. The knee actually has less pain and regains its function much more quickly if CPM is used. If the knee is taken out of the CPM for periods of time, it becomes stiff and more painful. Therefore, it is best to devote the first week following surgery to continuous use of the CPM at home. Two weeks after surgery, the sutures are removed and the patient can walk bearing full weight on the leg. Crutches are used from 1-6 weeks, depending on the type of graft that was used for the reconstruction.

WHEN CAN I EXPECT TO RETURN TO SPORTS FOLLOWING SURGERY?

Within two weeks after surgery, most patients are walking on level surfaces without a limp. Typically, a stationary bike can be used on post-operative day one. Most patients can be in a swimming pool after their sutures are removed at 2 weeks. When the knee has full range of motion (usually at six to eight weeks), muscle-strengthening exercises are done. At four months, jogging is permitted in a sports brace. Full sports competition is allowed once strength has returned, usually between 6-8 months. Full recovery takes approximately one year.

WHEN CAN I EXPECT TO RETURN TO ACTIVITIES AFTER SURGERY?

Most people can get back to desk work or sedentary activity one or two weeks after surgery. If the right knee has been reconstructed, it may be several weeks before the knee is strong enough to drive safely. For heavy work, it may take 3-6 months before the patient is medically cleared to return with no restrictions.

WORK	**RETURN**
Sedentary/Desk	1 to 2 weeks
General Office	2 to 3 weeks
Light	6 to 8 weeks
Medium	3 months
Heavy	4 to 5 months

SPORTS	**RETURN**
Normal walking/stairs	1 to 2 months
Light individual sports	3 to 4 months
Running	4 months
Contact/high performance	6 to 8 months

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WHAT ARE THE RISKS AND BENEFITS OF ACL TREATMENT?

NON-OPERATIVE

RISKS

- Repetitive injuries or giving way may cause further permanent joint damage
- Arthritis
- Inability to participate in sports that require pivoting

BENEFITS

- Avoidance of potential surgical complications

OPERATIVE

RISKS	%
Permanent numbness in the front of the knee near the incision	100
Other nerve injury	0.5
Patello-femoral pain (kneecap)	5
Flexion contracture (stiffness/reduced motion of the knee)	10
Reinjury (knee becomes unstable again)	5-10
Swelling	10
Superficial infection	1
Deep infection	0.5
Deep vein thrombosis (blood clots)	0.5
Delay in regaining motion	5
Vascular (damage to blood vessels)	0.01
Death	0.0

BENEFITS

- Return to work and sports with a stable knee
- Potentially prevent further injury to the knee
- Remain physically active

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ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION SURGERY

Here are guidelines that will help you to prepare for ACL reconstruction surgery:

PREOPERATIVE INSTRUCTIONS

BEFORE SURGERY:

Dr. Gill will see you in the office. He will do a preoperative history and physical examination and complete the necessary paperwork. He will write preoperative hospital orders and schedule an appointment with the pre-operative test center if needed. You will have an opportunity to speak with anesthesia and physical therapy. It is recommended that you utilize a stationary cycle to maintain your knee range of motion and improve the overall function of the knee prior to surgery.

SEVERAL DAYS PRIOR TO SURGERY:

Wash the knee with soap or Hibiclens several times per day to get the skin as clean as you can. This decreases the risk of infection. **Be careful not to get any scratches, cuts, sunburn, poison ivy, etc**. The skin has to be in very good shape to prevent problems. You do not need to shave.

THE DAY BEFORE SURGERY:

Please be in touch with Dr. Gill's office to confirm the exact time that you should report to the hospital for surgery. **You can have nothing to eat or drink after midnight on the day before surgery**. It is very important to have a completely empty stomach prior to surgery for anesthesia safety reasons. This included no chewing gum or drinking coffee. If you have to take medication, you can do so with a sip of water early in the morning prior to surgery (but later tell the anesthesiologist you have done so).

DAY OF SURGERY:

Please bring any crutches, brace, ice machine or imaging studies that you have received.

SURGERY:

The operation to replace the torn **anterior cruciate ligament** will be done arthroscopically. A small incision will be made on the inner side of the knee to take the graft from the middle of the patellar tendon together with a small piece of bone from the bottom of the kneecap and the upper part of the tibia (mid-third patellar tendon graft, "bone-tendon-bone"). The incision leaves a small area of numbness on the outer side of the upper leg. Most of this numbness clears but it takes a year or two and is not usually bothersome. In certain circumstances, the graft is a hamstring tendon or a donor graft from a cadaver (allograft).

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AFTER SURGERY:

Prior to surgery, a **continuous passive motion (CPM) machine** will be delivered to your home. This is a small apparatus that sits on the bed, and onto which your knee rests. The CPM very slowly bends and straightens out the knee. Once you get used to the machine, your knee pain and swelling will be much less. If you do not use a CPM and the knee is put into a splint, it often gets stiff and is more painful. Your initial recovery may be delayed (although the end result would likely be about the same).

You will be able to adjust the CPM with a **hand-controlled unit**. The most important part of using the CPM in your postoperative rehabilitation is **to get the knee out straight (extension).** The machine is set to **pause for five seconds in extension** to allow you to stretch the knee fully. How much flexion (bending) you gain initially is less important; how quickly the machine moves also is not as important. For the first several days, just allow the machine to bend the knee as much as is comfortable and gradually work on gaining more flexion as the week progresses.

- Set the initial CPM setting from 5 degrees of hyperextension to 40 degrees of flexion
- After 48 hours, try to have your knee and the CPM bending to at least 90 degrees of flexion.
- **The most important aspect is to get the knee out completely straight.**
- You will be able to **adjust the speed**: at night have the machine move as slowly as possible and you will be able to sleep better.
- During the day, you can speed up the machine and also gain more flexion.

You will be given a **prescription** for pain medication to take home with you. In addition to this medication, you should take one aspirin per day to help prevent blood clots (phlebitis) for 10 days. The pain medication has a tendency to make you constipated.

The **dressing** should be changed the day following surgery and can be removed at two days. The wound is sealed with steri-strips (small pieces of tape on the skin). You **can shower** on the second day following surgery, but be careful standing in the shower so that you **do not fall**. It is better to have a small stool to be able to sit on. However, you can get the leg wet and wash it. Do not submerge the knee under water in a bath, hot tub or swimming pool.

To help control swelling in the lower leg, you should wear the white stockings after surgery until your first post-operative visit. **If you develop calf pain or excessive swelling in the leg, call Dr. Gill's office.**

The **cryocuff** is a blue wrap that is put on the knee to keep it cold. You can use this as often as you want to cool down the knee to reduce swelling and pain. Check your skin every time that you remove the wrap to make sure that it is intact. Be sure to stock up on extra ice in your freezer.

For two weeks following surgery, it is best to be in the CPM at least 10 hours per day. You can get up as needed. It is best to get up more frequently for short periods of time. If you are out of the CPM for a long period of time, the knee tends to become more stiff and painful. This is not really a problem, but it takes a while to get the knee loosened up again and moving in the CPM. Thus, getting up more frequently for short periods of time is better than being out for a long period of time.

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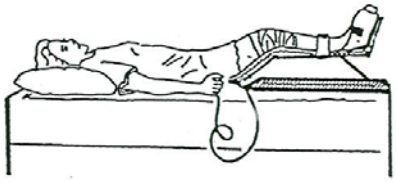
ACL Reconstruction Rehabilitation Guidelines

PHASE 1: 0-2 weeks after surgery

This handout is to use as a guideline for your **rehabilitation after anterior cruciate reconstruction**. You may vary in your ability to do these exercises and to progress from one phase to the other. Please call Dr. Gill's office if you are having a problem with your knee or if you need clarification of these instructions.

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



CONTINUOUS PASSIVE MOTION (CPM)

Use the CPM machine at home as much as possible - **at least 10 hours per day.** You may move the CPM to a sofa, the floor or onto a bed as you change positions and locations. Use the CPM at night while sleeping. Slow the speed 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 CPM should be programmed to include an extension pause of 5 seconds (in other words, when the knee is straightened out, it pauses to allow you to stretch it out straight). The flexion setting will start at 40 degrees and should be gradually increased to at least 90 degrees over the next 48 hours as you can tolerate more bending of your knee. (When a **meniscus repair** is done along with the ACL reconstruction, limit knee flexion to 90 °.) Continue to use the CPM after surgery until your first post-operative visit.

Do not place a pillow under the knee for comfort. This can lead to knee stiffness.

BRACE/CRUTCHES

Your knee brace is set to allow your knee to bend and straighten from 0 to 90 degrees. Use it when walking. In some cases, you may be sent home with the brace locked at 0 degrees (fully straight). After you arrive home, and the anesthetic nerve block has worn off, unlock the brace to allow 0 to 90 degrees of motion.

For patients with a patellar tendon autograft (from your own knee), put as much weight on your operated leg as possible when walking. You should use the crutches in the beginning, but can discontinue the crutches when you have confidence in the knee to support you. In some cases,

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crutches and restricted weight bearing may be necessary for longer periods. Dr. Gill or the physical therapist will give special instructions in these cases.

In cases where hamstring tendon autograft or an allograft is used, you will be advised to put partial weight (50%) on your leg with crutches and brace for the first 6 weeks after surgery.

In cases where a meniscus repair is done along with the ACL reconstruction, the brace should be locked fully straight when walking for the first 6 weeks after surgery.

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.

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.

ASPIRIN / ELASTIC STOCKINGS
Take an aspirin each morning, wear an elastic stocking (TED) below the knee, and do at least 10 ankle pump exercises each hour to help prevent phlebitis (blood clots in the veins) until your first post-operative visit.

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.

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EXERCISE PROGRAM

Perform exercises without your brace. See "Knee Exercises" handout for illustrations. You can view a video clip of most of the listed exercises by going to the Boston Sports Medicine and Rehabilitation Institute website: http://www.bostonsportsmedicine.com

Days per Week: 7 Times per Day: 3-4

Quadriceps setting	1-2 sets of 15-20 reps
Heel prop	5 minutes
Heel slides with towel assist	1 set of 5 to 15 minutes
Sitting heel slides	1 to 2 sets of 15 to 20 reps
Straight leg raises	1-2 sets of 15-20 reps
Patellar mobilization (**very important**!!)	1 set for 1 to 3 minutes
Hip abduction	3 sets of 10 reps
Ankle pumps	1 set of 2 to 3 minutes
Prone hang	5 minutes

START PHYSICAL THERAPY

- You can start formal physical therapy about 3 to 5 days after the operation.
- We ask that your PT follow our written protocol.
- If your PT has questions, please ask them to call us to discuss them.

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PHASE 2: 2 – 6 weeks after surgery

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 120 degrees or more
6. Decrease knee and leg swelling
7. Normal gait without crutches

CRYOCUFF

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

BRACE/CRUTCHES

In cases where the patellar tendon autograft is used, you can begin placing all of your weight on the operated leg when you walk unless otherwise instructed by Dr. Gill. Discontinue using your crutches when you are comfortable doing so. Continue using your brace when walking outside of the home. Within one or two weeks, you can usually discontinue use of the crutches if you have good control of the leg and are sure that you will not fall or get injured. Concentrate walking normally, in a heel-strike to toe-off pattern, without a limp. Occasionally (every one or two hours) practice standing on your operated leg, with your knee fully straight, for 10 to 20 seconds.

In cases where hamstring autograft or allograft is used, you will be advised to put partial weight (50%) on your leg with crutches and brace for the first 6 weeks after surgery.

In cases where a meniscus repair is done along with the ACL reconstruction, the brace should be locked fully straight when walking for the first 6 weeks after surgery.

SWELLING

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

EXERCISE PROGRAM

Stationary Bicycle

Days per week: 5-7 Times per day: 1-2

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 may ride the cycle

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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.

Water Workout (optional)
Days per week: 3 Times per day: 1
Aqua-jogger exercise or Flutter kick swimming 20-30 minutes

RANGE OF MOTION AND STRENGTHENING EXERCISES (brace off)
Days per Week: 5-7 Times per Day: 1-2

Quadriceps setting	1-2 sets of 15-20 reps
Heel prop	5 minutes
Prone hang	5 minutes
Heel slides with towel assist	1 set of 5 to 15 minutes
Straight leg raises	1-2 sets of 15-20 reps
Standing hamstring curl	3 sets of 10 reps
Standing toe-raises	3 sets of 10 reps
Hip abduction	3 sets of 10 reps
1/3 knee bends	3 sets of 15 reps
Wall slides	3 sets of 15 reps

OPTIONAL ADDITIONAL EXERCISES

If you did not have a meniscus repair, you can start the Leg Press and Hamstring Curl machine during this phase under supervision of a physical therapist if you have achieved the following goals:

1. Full passive knee extension
2. Full extension while quadriceps setting
3. Flexion of 125 degrees
4. Minimal swelling

You can view a video clip of most of the listed exercises by going to the Boston Sports Medicine and Rehabilitation Institute website:
http://www.bostonsportsmedicine.com/protocols_therapy_videos.html

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PHASE 3: 6-12 weeks after surgery

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

BRACE

The brace is discontinued after you see your surgeon at your 6-week post-operative office visit. Concentrate on walking with a heel-toe gait without a limp. In some cases, use of the brace will continue if the knee requires a longer period of protection.

CRYOCUFF/ICE Continue to use the cryocuff for 20 minutes after each workout

EXERCISE PROGRAM

Range of Motion and Strengthening Exercises

Days per week: 3 Times per day: 1

Quadriceps setting	1-2 sets of 15-20 reps
Heel prop	5 minutes
Prone hang	5 minutes
Heel slides with towel assist	1 set of 5 to 15 minutes
Straight leg raises	3 sets of 10 reps
Standing hamstring curl	3 sets of 10 reps
Standing toe-raises- single leg	3 sets of 10 reps
Hip abduction	3 sets of 10 reps
Squat to chair	3 sets 15 reps
Wall slides	3 sets of 15 reps
Single leg strengthening progression	see timeline

Stretching Exercises

Days per week: 5-7 Times per day: 1-2

Hamstring stretch	3-5 reps holding 15 to 30 seconds
Quadriceps stretch	3-5 reps holding 15 to 30 seconds
Calf Stretch	3-5 reps holding 15 to 30 seconds

Optional Additional Weight Training

Days per week: 2-3 Times per day: 1 3 sets of 20 repetitions

The following exercises may be added to your exercise program about 6 weeks after surgery:

Seated Leg Press	Roman Chair
Hamstring Curl	Calf Raise Machine
HIP Abductor/Adductor Machine	Hip Flexor Machine

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Cardiovascular Conditioning
Days per week: 1-2 Times per day: 1 Duration: 20-30 minutes

The following can be performed for conditioning: stationary bicycle, walking, rowing, elliptical trainer, and water workout

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.

Phase 3 Exercise Program Summary:
Frequency: 3 times a week 3 sets of 10-15 repetitions

- Leg Press
- Hamstring Curl
- Wall Slides
- Roman Chair
- Chair Squat
- Calf Raises or Calf Raise machine
- Hip Abductor/Adductor machine
- Hip Flexor machine
- Single leg strengthening progression
- Hamstring, Calf and Quadriceps stretching
- Quadriceps setting 20 repetitions, 3 times a day with heel prop

***If you do not have access to gym equipment, the following exercises from Phase 2 can be substituted using ankle weights (Start with one pound and add one pound a week until 5 pounds): Straight leg raise, Side lying abduction, and Standing hamstring curl.

Precautions When Exercising
- Avoid pain at the patellar tendon 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

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DO NOT do any of the following exercises:

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

If you have any questions regarding the exercise program, call 781-251-3535

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PHASE 4: 12-16 weeks after surgery

GOALS

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

EXERCISE PROGRAM

Muscle Strengthening Exercises

You should continue muscle-strengthening exercises from Phase 2 and 3 on a three times a week basis. At this time, you can decrease the number of repetitions per set from 15 to 10. This will allow you to work with more resistance. Remember to do all exercises slowly, with good form. You may begin to hold dumbbells when doing the chair squat, single-leg 1/3 knee bends and single-leg wall slides. Weights can be increased when you can do a particular weight easily, for 3 sets of 10 repetitions, for 3 consecutive workouts. At all times, be cautious of pain or crunching at the kneecap or patellar tendon while exercising. You may use resistance machines at your gym, but do not use the knee extension machine and do not do lunging or high impact drills.

Cardiovascular Conditioning

You can use the elliptical trainer, 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 this area. Please note that excessive long duration cardiovascular exercise can retard or delay muscular strength development when strength improvement and gains in muscle size are the programs' primary goal.

At this time, light running on a soft level surface with a sports brace can begin if your surgeon advises. You need to have full range of motion, good strength and no swelling to run safely. If you run, 3 times per week for 10 minutes is advisable for the first 2 weeks. If there is no pain or swelling, you can increase your running time by 1 minute per session for a maximum of 30 minutes. Walking and hiking on gentle trails can also be used for conditioning activity.

Jump and Plyometric training

With the approval of the doctor and physical therapist, you can begin the Jump and Plyometric Training Progression that is included in this packet.

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 %

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- 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
Days per week: 2-3 Times per day: 1 3 sets of 10-15 repetitions

- 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
- Hamstring Curl
- Wall Slides (hold dumbbells for resistance)
- Roman Chair (strengthens hamstrings)
- Chair Squat (hold dumbbells for resistance)
- Calf Raises or calf raise machine
- Hip Abductor/Adductor machine
- Hip flexor machine
- Single leg strengthening progression

PRECAUTIONS
The following exercises can cause injury to the knee and are usually not recommended at this time:

- Leg extension machine (quadriceps extensions)
- Stairmaster or stair climber machines
- Lunges
- Squats past 90 degrees of knee flexion
- High Impact and plyometric exercises

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PHASE 5: 16-24 weeks after surgery

Cardiovascular Conditioning
Continue with the program outlined in phase 4

Muscle Strengthening Exercises
Continue with the program outlined in phase 4

Speed and Agility Training
Refer to Speed and Agility Progression

Jump and Plyometric Training
Refer to Jump and Plyometric Progression

Sports-Specific Training
To reach your ultimate goal of returning to sports participation, you must follow an orderly sequence of drills that are designed to re-train the muscle-to-joint coordination that is necessary to provide the proper control of your knee. The following time-table illustrates an ideal progression sequence:

Activity	Weeks post-surgery
Running slowly	12-16
Golf	16-20
Roller blading	18
Tennis	20-24
Return to sports practice	24-32
Full return to sports	32-36

The sports physical therapists can provide you with specific instructions for each step in the sequence.

Returning to Sports
You should discuss the exact timing of return to sports activities and brace use with Dr. Gill.

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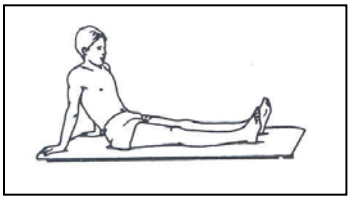
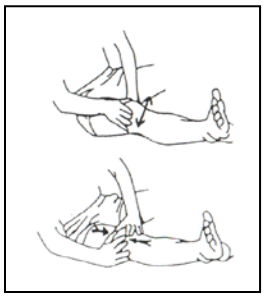
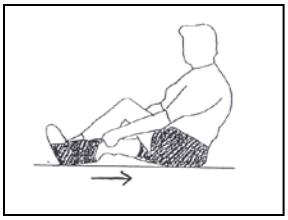
Knee Exercises for ACL Reconstruction



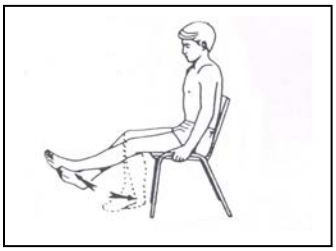
Quadriceps setting to maintain muscle tone in the thigh muscles and (extend) straighten the knee. Lie on your back or sit with the knee extended fully straight as in the figure. Tighten (contract) and hold the front thigh muscle (quadriceps) making the knee flat and straight. If done correctly, the kneecap will slide slightly upward toward the thigh muscle. The tightening action of the quadriceps muscles 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. **Also try to do any time your knee is out of CPM.**



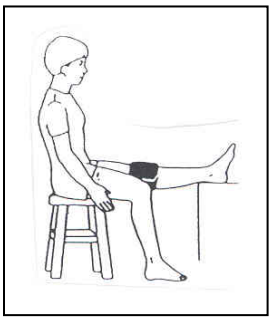
Patellar Mobilization to prevent scar tissue from binding the kneecap. With the knee fully straightened, grasp the edges of your kneecap between your thumb and index finger. Move the kneecap side to side and up and down.



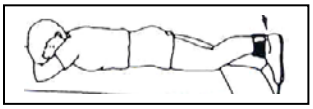
Heel Slides to gain knee flexion. While sitting or lying on your back, actively slide your heel backward to bend the knee. Keep bending the knee until you feel a stretch in the front of the knee. Hold this bent position for five seconds and then slowly relieve the stretch and straighten the knee. While 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. For patients who have had a meniscus repair along with the ACL reconstruction, limit knee flexion to 90° . See illustration. Repeat 20 times, three times a day.



Sitting Heel Slides to regain the bend (flexion of the knee).When sitting in a chair, slide the heel backward as if trying to get the foot underneath the chair (figure 5). Hold 5 seconds and slowly relieve the stretch by sliding the foot forward. You can help with the opposite foot if necessary. For patients who have had a meniscus repair along with the ACL reconstruction, limit knee flexion to 90° . See illustration. Repeat 20 times, three times a day.



Heel Prop to straighten (extend) the knee. Lie on your back with a rolled up towel under your heel or sit in a chair with the heel on a stool as shown. Let the knee relax into extension (straight). If the knee will not straighten fully, you can place a weight (2 to 5 pounds) on the thigh, just above the kneecap. Try to hold this position for 5 minutes, three times a day. While maintaining this extended position, practice quadriceps setting.



Prone Hang to straighten (extend) the knee. Lie face down across your bed so that the kneecap is just off the edge of the mattress. Let your leg drop down toward the floor so that your knee straightens fully. If the knee will not fully extend, then attach a weight around the ankle to help pull the leg down. Use an amount of weight as described above for the heel prop exercise. Try to hold this position for 5 minutes, three times a day.

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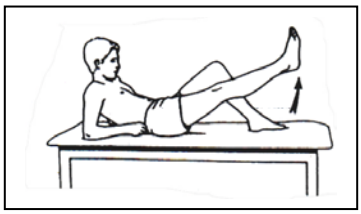
Straight Leg Lift

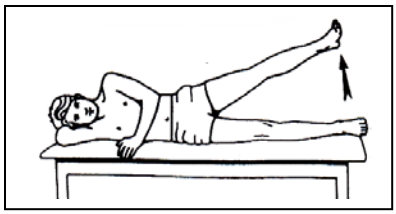
The quality of the muscle contraction in this exercise is what counts the most, not just the ability to lift the leg!

1. Tighten the quadriceps (quadriceps setting) as much as you can, push the back of the knee against the floor.
2. Tighten this muscle harder!
3. Lift your heel 4 to6 inches off the floor
4. Tighten the quadriceps harder again.
5. Lower your leg and heel back to the floor. Keep the quadriceps as tight as possible.
6. Tighten this muscle harder again.
7. Relax and repeat

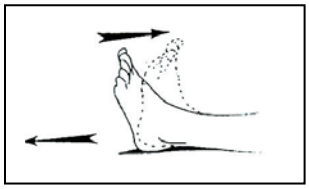


If the knee bends when you attempt to lift the limb off of the bed, do not do this exercise. Keep trying to do the quadriceps setting exercise until you can lift the limb without letting the knee bend.

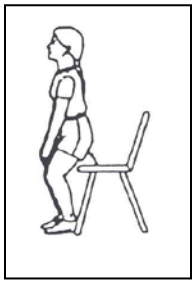
Hip Abduction
Lie on your unoperated side. Keep the knees fully extended. Raise the operated limb upward to a 45 degree angle as illustrated. Hold one second, then lower slowly.



Ankle Pumps to stimulate circulation in the leg.
Move your foot in an up and down motion 30- 40 times a minute.



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, pause 1 to 2 seconds and return to the full upright position.



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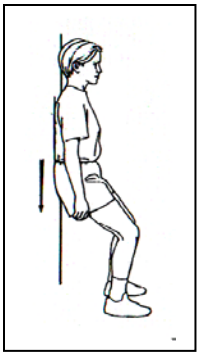
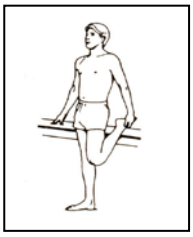
Wall Slides
Stand upright with your back and buttocks touching a wall. Place the feet about 12 inches apart and about 8 inches from the wall. Slowly lower your hips by bending the knees and slide down the wall until the knees are flexed about 45 degrees (illustration). Pause five seconds and then slowly slide back up to the upright starting position. Do 3 sets of 10 to 15 repetitions.

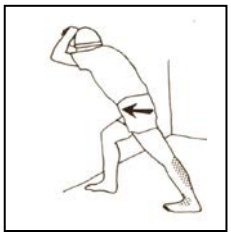


Hamstring Stretch Perform this stretch in the position illustrated at the right. Bend slowly forward at the hips, keeping the knee fully extended until you feel gentle stretch in the back of your thigh and knee. Hold the stretch for 15 to 20 seconds and repeat 3 to 5 times.

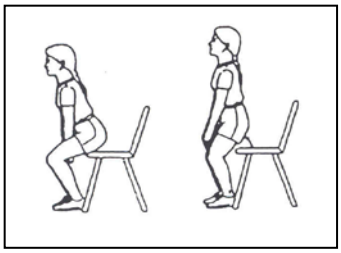
Quadriceps Stretch
This stretch is performed in the position illustrated at the right. Lean gently Backward as if bringing you heel toward the buttock. When a stretch is felt in the front of the thigh and knee, hold 15 to 20 seconds for 3 to 5 repetitions.



Calf/Achilles 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, 3 to 5 repetitions.



Squat to Chair
In the chair squat exercise, you lower your buttocks toward the chair until your buttocks touch the chair. Do not sit or rest at the chair, but instead immediately and slowly return to the standing and starting position. 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 each hand. You may add 2 to 3 pounds per week until you reach 10 pounds in each hand**.**



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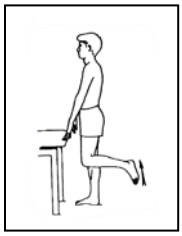
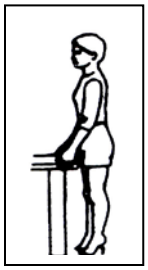
Standing Hamstring Curl



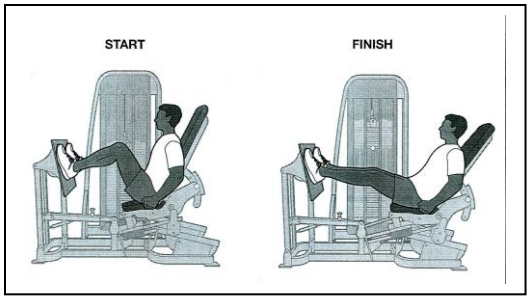
Stand facing the wall, using the wall for balance and support.
while standing on the unoperated limb bend the knee of the operated side and raise the heel toward the buttock. Hold this flexed position for one second. Slowly lower the foot back to the floor. Keep the thighs aligned as illustrated.

Standing Toe Raises



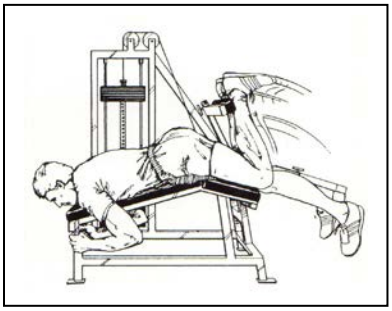
Stand facing a wall, hands on the wall for support and balance. Keep the knees extended fully. Tighten the quadriceps to hold the knee fully straight. Raise up on 'tip-toes' while maintaining the knees in full extension. Hold for one second, then lower slowly to the starting position.

Seated Leg Press



Use an amount of weight that feels easy enough to perform 20 repetitions as the starting weight for this exercise. 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. In this exercise, avoid letting the knees **snap** or drop suddenly into extension when reaching the fully straightened position. Avoid starting the exercise with the knees excessively bent. Do not bend the knee so far that your calves and back of thighs touch. Adjust the seat position to limit the excursion of the machine.

Resisted Hamstring Curls



If you have access to a hamstring curl machine (illustration), you may start using it. As with the leg press, start with a reasonable weight and use that weight for the first week. You may increase the weight by 3 to 5 pounds every 10 days as long as you can perform 3 sets of 20 repetitions slowly, with good form. If you do not have access to a hamstring machine, continue doing the standing hamstring curl adding an ankle weight for resistance. Start with 3 to 5 pounds and add 1 pound per week until you build to 10 pounds for 3 sets of 15 repetitions.

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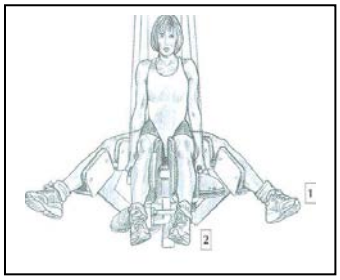
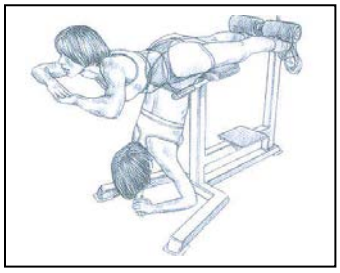
Additional Weight Training

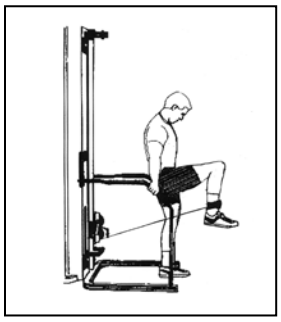


Hip Abductor/Adductor Machine

Calf Raise Machine



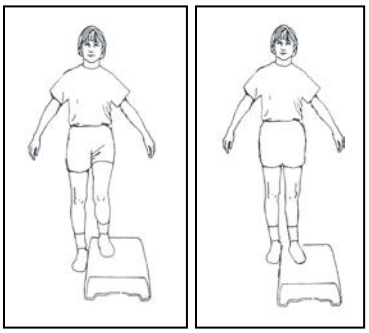
Roman Chair



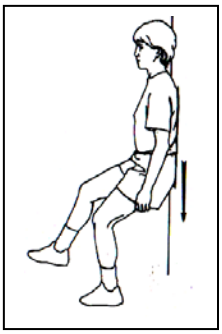
Hip Flexor Pulls

Single Leg Strengthening

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 degree (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.



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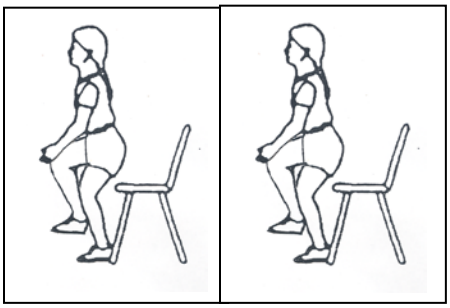
Single Leg Squat Exercise
In the single leg squat exercise, you stand on the single leg and then lower your buttocks toward the chair. Slowly return to the standing and starting position. Remember to keep your head over your feet and bend at the waist as you descend. You do not have to squat all the 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

These 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. Your ability to progress through this program may be limited by the presence of other knee problems. It is recommended that you follow this program as written, step-by-step. The progress of your strengthening will be evaluated by the physical therapist using these particular drills and the timeline in the progression.

Step Up-Down Exercise
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 sets 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
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.

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Single Leg Squat

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 1 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, you can decrease the strength workouts to 2 times a week and do 1 set of 10 of each of the three drills only, as a maintenance workout.

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Speed and Agility Progression

Goals

1. Safely recondition the knee 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

Phases of Training

Straight ahead running phase
Direction change running phase
Unrestricted direction change and impact phase

Prerequisites

Full Range of Motion
Strength at least 80 % of uninjured limb
Thigh girth within ½ inch of unaffected limb
No tenderness at the graft harvest site
Symmetrical quadriceps and hamstring flexibility
Perform and pass functional tests
Obtain clearance from your doctor or physical therapist

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 yards

Warm-up, Stretch and Ice

Be sure that you warm-up and stretch before and after workouts. Generally, you should do some walking, cycling or elliptical so that you break a sweat before starting the running program. You can then stretch before beginning the running drills. Ice your knee for 20 minutes following workouts and stretch all muscle groups as you are cooling down.

Recommended Frequency 2-3 times per week

Criteria to Progress

Do not progress to the next step in the phase until the present step is pain free, and you can perform with proper technique and without difficulty (muscle soreness or fatigue). Add only one new step in the progression per workout.

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I. Straight Ahead Running (16-20 weeks)

1. Run ½ speed 100 yards, 10 repetitions
2. Run ¾ speed 100 yards, 10 reps
3. Run ½ speed 100 yards, 3 reps; ¾ speed 100 yards, 3 reps; full-speed 50 yards, 4 reps
4. Continue ½ and ¾ speed 100-yard runs, for 3 reps each and add one 50-yard run each workout until you can do (10) 50-yard full speed runs.

II. Basic Change of Direction Running (20-24 weeks)

Intensity: Progress drills from walking → ½ speed → ¾ speed → full speed
Continue current workout from above (Step 4): Run ½ and ¾ speed 100 yd runs for 3 reps each. Run full speed 50-yard run for 5 reps

Progressively add each step below:

5. Zig-Zag run, round corners, 50 yards, 5 reps
6. Backward run 25 yards to gradual stop, then forward run 25 yards to gradual stop, 5 reps
7. Circle run 20 feet or greater diameter circle, 3 reps to left and 3 reps to right
8. Figure '8' run 20 feet or greater length, 5 reps
9. Carioca 50 yards, 5 reps left, 5 reps right

III. Advanced Speed and Agility Running (24 weeks onward)

Intensity: Progress drill from walking → ½ speed → ¾ speed → full speed

Continue current workout above and progress with below:

10. Run forward to plant-and-cut off of the unoperated limb, ½ speed, 5 reps
11. Run forward to plant-and-cut off of the operated limb, ½ speed, 5 reps
12. Zig-Zag drill with alternate limb plant-and-cut, 6 reps
13. Box drill 20 yards square, 6 reps, alternate sides
14. Shuttle run 50 yards with direction change every 10 yards, 5 reps
15. Agility run, 5 reps, alternate starting sides

Suggested Final Workout Summary:

1. 100-yard run ½ speed, ¾ speed and full speed each distance 2 reps each
2. Zig-Zag run, 6 reps
3. Forward/backward run, 6 reps
4. Circle run, 6 reps
5. Figure '8' runs, 6 reps
6. Carioca, 6 reps each way
7. Shuttle run 50 yards with direction change every 10 yards, 6 reps
8. Box drill 20 yards square, 6 reps, alternate starting side
9. Agility run, 6 reps, alternate starting side

IV: Begin Sports Practice

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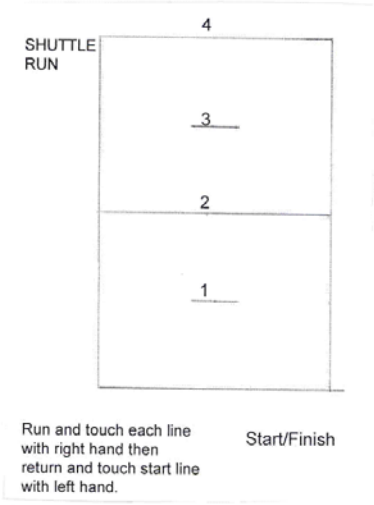
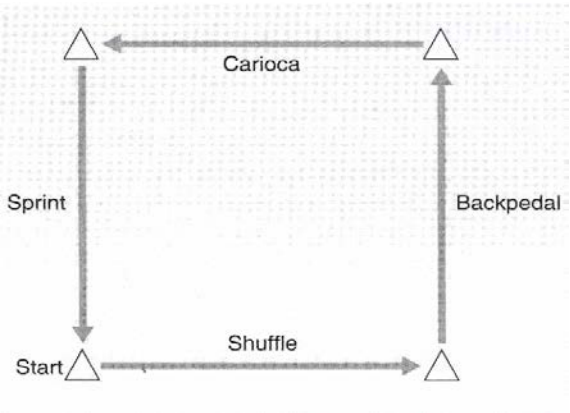
Agility Drills

Shuttle Run



Box Drill



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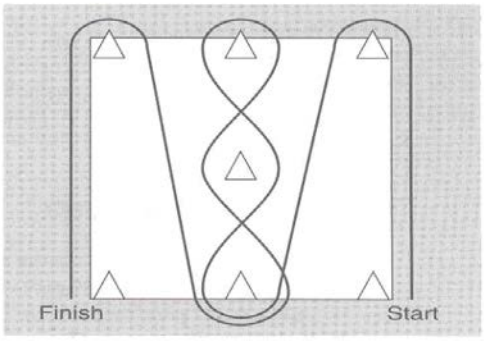
Agility Drill



Jump and Plyometric Training Progression

Goals
1. Safely condition the knee and lower limb for the demands of jumping and landing during sports activity
2. Provide a logical sequence of progressive drills for pre-sports conditioning
3. Provide objective criteria for safe progression from training to sports participation

Phases of Training
Double-leg training
Double-leg complex training
Single-leg training

Recommended Frequency 2 times per week

Sequencing
Begin each training session with a warm-up routine. Perform the jumping drills listed in the appropriate phase of your rehab. Be sure to limit your total contacts (or jumps) to the suggested amount listed for each training session to prevent injury. Progress within the phase as you master each exercise, performing each jump with proper technique and without pain.

Warm-up and Stretch
Generally, you should cycle, jog or use an elliptical trainer, rower or other device for 15 to 20 minutes so that you break a sweat before starting the program. After completing the jumping drills, cool down by stretching for 15 to 20 minutes.

Criteria to progress
Do not progress to the next step in the phase until the present step is pain free, and you can perform with proper technique and without difficulty (muscle soreness or fatigue).

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Technical Essentials

Each hop or jump should be performed with concentration on good technique. Perform each jump with a 'stick' landing, i.e. you should land and hold your balance momentarily before proceeding to the next jump. Keep the feet apart and do not let the knees rotate inward when taking off or landing. Soften the impact by landing on the balls of the feet and land with some bend in the knees and hips.

Precautions

Do not begin jump/plyometric training without clearance from your doctor and physical therapist. Jump training places heavy loads on the kneecap, patellar tendon and knee joint surfaces. Pain at these areas during jumping exercises should be reported to your physical therapist.

Beginning at Phase 3 (12-16 weeks) **Limit 60 foot contacts/session**

1. Double Limb (DL) hops on mini-trampoline
2. DL hops on soft surface (carpeted floor, gym floor)
3. DL Jump rope

Suggested Final Workout:

- DL hops on mini-trampoline x 30 repetitions
- DL hops on soft surface x 10 reps
- DL hops with jump rope x 20 reps

Beginning at Phase 4 (16-20 weeks) **Limit 90 foot contacts/session**

4. DL forward hop, 6-12" distance
5. DL side-to-side hops, 6-12" distance
6. DL broad jumps, 12-18" distance
7. DL broad jump-to-vertical jump
8. Jump rope, alternating single limb (SL) hops

Suggested Final Workout:

- Warm-up with DL jumps on mini-tramp or jump rope x 30 reps
- DL forward hop x 5 reps
- DL side-to-side hops x 5 reps each side
- DL broad jumps x 5 reps
- DL broad jump-to-vertical x 5 reps
- Jump rope, alternate SL hops x 30 reps

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Beginning at Phase 5 (20-24 weeks) **Limit 120 foot contacts/session**

9. 90° DL Jump
10. 180° DL Jump
11. DL broad jump-to-vertical with 90°-180° turn
12. Single limb (SL) hops in place on mini-trampoline
13. Jump rope, double/triple SL hops, alternating feet
14. SL forward hop, 6-12" distance
15. SL side-to-side hops, 6-12" distance

Suggested Final Workout:

- Warm-up with mini-tramp or jump rope with DL → SL hops x 30-60 reps
- DL forward hops (x 5 reps) and side-to-side hops (x 5 reps each direction)
- 90° to 180° DL Jumps x 5 reps each
- DL broad jump-to-vertical with 90° to 180° turn x 5 reps each
- SL forward hops (x 5 reps) and side-to-side hops (x 5 reps each direction)

During this phase, drills can be advanced with exercises jumping over cones/hurdles and use of an agility ladder.

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Post-Op Phase	WB Status/ Brace	ROM	Strength Training and Plyometrics	Balance and Proprioception	Conditioning and Agility	Restrictions and Precautions	Criteria to Progress
Phase 1: 0 to 2 weeks	WBAT with crutches Brace 0-90° when ambulating PWB for HS and Allograft	CPM 7-14 days; 10 hours/day Week 1: 0-100° Week 2: 0-120°	Q Sets, SLR, Ankle Pumps, Active ROM	Weight Shifts Pre-gait training	Stationary Bike	Avoid pivoting and varus/valgus stresses No resisted open-chain knee extension	1. WBAT 2. Full Passive Knee Extension 3. Flexion 90° 4. Good Quad Set producing TKE
Phase 2: 2 to 6 weeks	FWB; D/C crutches once ambulating safely with good quad control Continue with Brace 0-90° Continue PWB for HS and allograft	Progress to full ROM	Add: Mini Squats Partial Wall-Slide Toes Raises Standing Ham Curl Hip Abduction	Single Leg Standing Balance Master: WB/Squat for symmetry	Aqua Jogger	Avoid pivoting and varus/valgus stresses No resisted open-chain knee extension	1. Demonstrates normal gait without brace 2. Full Passive Ext. 3. Flexion > 125° 4. Full SLR, no lag 5. No increased pain at graft site 6. Stable pain rating 7. No new swelling after workouts
Phase 3: 6 to 12 weeks	FWB No Device D/C brace Wean to FWB for HS and allograft	Full ROM Active stretching all muscle groups	Progress to gym equipment (Leg Press, Ham Curl, hip ABD/ADD) Initiate Single Leg Progression Initiate Jump Progression: Double Limb on/off Trampoline (Limit 60 contacts/ session)	DL Standing on unstable surface: wobble board, foam; A/P, Lateral Star Drill A/P, Lateral reaches (Lunge) multi-step and load	Elliptical Trainer Swimming	Avoid pivoting and varus/valgus stress No resisted open-chain knee extension Stairmaster/Impact exercise Avoid patellofemoral overload	1. Full ROM 2. Single Leg Step down 6” x 5 reps 3. SLWS 60° x 5 reps 4. SL Squat 60° 5 sec hold x 5 reps 5. Jog 100’ no limp 6. DL hop in place with good GR for 30 sec 7. DL hop for distance

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Post-Op Phase	WB Status/ Brace	ROM	Strength Training and Plyometrics	Balance and Propriocreption	Conditioning and Return to Sports	Restrictions and Precautions	Criteria to Progress
Phase 4 12 to 16 weeks	Sports Brace	Full	Jump Progression **Double Limb** 1. Directional Hops on flat, even surfaces (A/P, Lat) 2. Broad Jump 3. Broad Jump to Vertical Jump 4. Wall Jumps (Limit 90 contacts/ session)	SL standing on unstable surface: wobble board, foam DL Squats on foam/wobble board/BOSU Star Drill Multi-directional reaches	Jogging, flat surface (Track, Treadmill)	Limited straight ahead jogging/running with brace Patellofemoral precautions	1. Girth within ½” 2. Single Leg Step Down 6” x 10 reps 3. SLWS 60° x 10 reps 4. SL Squat 60° x 10 reps 5. Run 100 yards with normal stride 6. DL hop tests
Phase 5: 16 to 24	Sports Brace	Full	Jump Progression **Double Limb** 1. 90° to 180° jump 2. Jump up/down from step 3. Series Jumping: Jump from height → controlled land → vertical jump	Progress SL tasks with perturbations, ball toss Progress Star Drill with increase speed, added weight or resistance, unstable surface	Running Progression: Acceleration and deceleration; change of direction Basic Agility Drills (Progression from walk →1/2 speed → ¾ speed) Figure 8 Carioca Shuttle Run Box Drill Ladder Drills	Patellofemoral precautions	1. SL hop for distance 2. 6-m timed hop 3. Triple hop for distance 4. Crossover hop for distance (Score of above tests within 15% of uninvolved limb)

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			Single Limb 1. Hop in place on/off trampoline 2. Directional hops on flat, even surface (A/P, Lateral) (Limit 120 contacts/ session)				
Phase 6: 24 Weeks onward	Sports Brace	Full	Progressive jump training		Full speed agility drills and Sports Specific Training		Per speed/agility and jump progressions