



ARNOLD & COX KNEE AND SHOULDER CENTER
ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION
ACCELERATED REHABILITATION PROTOCOL
Dr. Christopher A. Arnold

Here are guidelines that will help you with your anterior cruciate ligament reconstruction surgery.

After Surgery:

When you wake up in the recovery room, your knee may already be moving very slowly on a continuous passive motion (CPM) machine. This is a small apparatus that sits on the bed onto which your knee rests. The CPM very slowly bends and straightens out the knee. Once you get used to the machine, it actually hurts much less and your rehabilitation is much quicker if you use a CPM.

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 is not immediately important; how quickly the machine moves also is not 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. By the end of the week it would be nice to get up to 90 degrees of flexion, but this is not critical. The most important aspect is to get the knee out 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 use this time to gain more flexion. It is extremely important to **remove** your brace when you are in your CPM.

The dressing may be removed two days following the surgery. If your incision is closed with sutures or staples, then clean the wound with betadine and cover the wound with 4x4 gauze until the sutures/staples are removed. The wound is sealed with steri-strips. These will naturally fall off in time. If you have an incision that is closed with staples or sutures, you may NOT get the knee wet when you shower.

Your knee and lower leg may swell following the surgery. You should use the elastic stockings (TED hose), and keep these on both legs until you are up and around more than you are down at rest. You should also take one regular Aspirin (325 mg) daily (unless you are allergic to Aspirin or have a history of ulcers). If you develop calf pain or excessive swelling in your leg call Dr. Arnold's office.

You should keep ice on your knee as often as you want to reduce swelling and pain.

For one week following surgery, it is best to be in the CPM for approximately 23 hours a day. You can get up whenever you want to but 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 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 for short periods of time is better than being out for long periods of time.



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Continuous Passive Motion Machine

- Place CPM on flat surface
- Plug IN

Check Control Settings in Hand-Control

- Flexion: increase to 90 degrees as tolerated
- Extension: 0 to -5 degrees
- Speed control as tolerated
- Power: on
- REMOVE your brace when your are in your CPM

For Safety, it is advisable to place a pillow lengthwise between the legs to avoid any interference

The CPM machine is to increase the range of motion of your knee; this machine will NOT strengthen your muscles.

When your knee flexion reaches 90 degrees of motion, measured by your therapist, you may discontinue the machine

If you have any questions about the operation or advancement of the CPM you may ask your therapist.

To return the CPM machine you should contact the company who provided the machine to you – this information should be provided on the side of the machine. You may also call the provider if you experience any mechanical problems with the machine.



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This protocol is a guideline for your rehabilitation after ACL reconstruction. Your own rehab may vary in your ability to do these exercises and to progress from one phase to another. Please call Dr. Arnold's office if you are having a problem or for any clarifications of these instructions.

PHASE I – The first week following surgery

You will go home with a knee immobilizer, crutches, and a CPM machine.

Goals:

1. Protect the reconstruction – Avoid falling
2. Ensure wound healing
3. Attain and maintain full knee extension – VERY IMPORTANT
4. Gain knee flexion to 90 degrees
5. Decrease knee and leg swelling
6. Promote quadriceps muscle strength/contraction
7. Avoid blood pooling in the leg veins

Activities:

1. CPM MACHINE – Use the CPM machine at home as much as possible. You should use the machine at least 6-8 hours per day, coming out of the machine only to eat, bathe, toilet and exercise. You may move the machine to a sofa, the floor, or onto a bed as you change positions and locations. Extension on the machine should be set at minus five (-5) degrees at all times to help your knee extend. *It is very important that you straighten the knee out 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.) The flexion setting should start at 30-40 degrees and should gradually be increased to 90 degrees as you can tolerate more bending of your knee.
2. BRACE/CRUTCHES – Your knee brace is set for full extension. Use it when walking. 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 that the knee will support you.
3. COLD APPLICATION – You should use ice following your surgery for a minimum of 20 minutes for each waking hour to decrease the swelling. You may use ice more if needed to cool the knee area. Do NOT let the ice come in direct contact with your 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. If you have staples/sutures DO NOT /get the knee wet (i.e. shower) until you return to our office. After removing the dressing, if you have staples/sutures,



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ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION
ACCELERATED REHABILITATION PROTOCOL

Dr. Christopher A. Arnold
(Phase I continued)

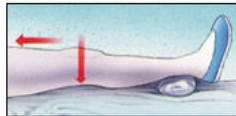
keep the wound covered with gauze. You may cleanse the area with betadine or Hydrogen Peroxide. *Do not use medicated ointments.*

5. ASPIRIN / ELASTIC STOCKINGS – Take one Aspirin (325 mg) per day. You should wear your elastic stockings (TED hose) on both legs until you are up and around more than you are down at rest.

Exercise Program

These exercises should be done starting on the second day following surgery, As You Can Tolerate Them. When you are not in your CPM machine, you should ensure that you are *not* sitting with a bend in your knee. Work on keeping your knee straight at all times. These exercises will assist in these efforts:

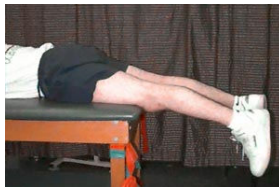
1. QUAD SETTING (to maintain muscle tone in the thigh muscle and straighten the knee) – Sit in a chair or lie on you back with the knee extended fully. Tighten and hold the front thigh muscle making the knee flat and straight. The kneecap should slide slightly upward toward your thigh muscle. Hold each contraction for 5 seconds. Do 20 repetitions three times a day.



2. ANKLE PUMPS (to stimulate circulation in the leg) – Flex and extend your ankle 10 times each hour.



3. PRONE HANG (to straighten the knee) – Lie face down on 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. Over time, if the knee will not straighten fully you may attach a small weight to your heel (2-3 lbs for women, 3-5 lbs for men). Try to hold this position for 5 minutes, three times a day.





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Other Exercises to be performed may include:

EXTENSION EXERCISES

Seated Hamstring Stretch
Calf Stretch (Gastrocnemius)
Heel Prop in supine or seated position

FLEXION STRETCHES

Heel slides in supine or long sitting with towel
Active assisted flexion in sitting

STRENGTHENING

Ankle Pumps
Quad Sets
Hip Abduction in supine or long sitting (perform with no extension lag to affected leg)
Hamstring Curls
Hip Flexion
Calf Raises in long sitting position

You should return to see a nurse in 7 to 10 days following your surgery. At this visit, you will undergo a wound check and your progress will be checked. You will begin to see the physical therapist for exercise instruction. An appointment will be scheduled to return to see Dr. Arnold in one month. You will probably be able to discontinue the CPM at this time. If you have any questions or problems, call Dr. Arnold's office at 479-966-4197.



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ACCELERATED REHABILITATION PROTOCOL
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Phase II – The 2nd, 3rd, and 4th 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 up to 120 degrees or more
6. Decrease knee and leg swelling
7. Normal gain without crutches

Activities:

1. COLD APPLICATION – continue to use ice while resting or after any activities to reduce swelling or pain as previously instructed. You can use ice as often as you like.
2. BRACE / CRUTCHES – begin placing all of your weight on you operative leg when you walk. Discontinue your crutches when you are comfortable doing so. Continue the use of your brace when walking outside the home until your are confident that you can walk safely without the brace. Within one or two weeks, you can usually wean yourself out of the brace under the direction of your physical therapist. Do not discontinue your brace until you can lift your leg straight up off of a level surface without any bend or lag in your knee. Concentrate on walking normally, in a heel-strike to toe-off pattern, without a limp.
3. SWELLING – Continue to use elastic stockings for the lower legs. You may wrap the knee with an ACE bandage to assist with controlling swelling. If you can tolerate anti-inflammatory medications then taking an over the counter anti-inflammatory (Ibuprofen, Aleve, Advil) can be helpful in assisting with swelling and discomfort.

Exercise Program – continue doing all the exercises from Phase I. You should add the following exercises (unless instructed by Dr. Arnold or your physical therapist). These exercises should be done with the brace off.

1. SITTING HEEL SLIDE (to regain flexion of the knee) – When sitting in a chair, slide the heel backwards as if trying to get the foot underneath the chair. Hold for 5 seconds and slowly relieve the stretch by sliding the foot forward. You can help with the opposite foot if necessary. Repeat 20 times, three times a day.
2. 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. Begin with no resistance for up to 10 minutes 2 to 3 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 full bottom position. You should then actually ride the bicycle with your forefoot resting on the pedal.



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**ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION
ACCELERATED REHABILITATION PROTOCOL**

Dr. Christopher A. Arnold
(Phase II – continued)

3. TOWEL STRETCH WITH QUAD SETTING – While sitting on the floor or bed, loop a towel around the foot of the operated knee. Let the knee straighten and flatten against the surface you are sitting on. Pull gently on the towel with both hands until the heel lifts slightly from the surface while keeping the back of your knee and calf against the surface. While holding this position, tighten the quadriceps and hold for 5 seconds.
4. 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 on your “tip-toes” while maintain the knees in full extension. Hold for one second then lower slowly to the starting position.

Other Exercises to be performed under the care of your physical therapist:

STRETCHING EXERCISES

Continue with stretches from phase one

If full knee extension has not been obtained use prone hangs or heel props with overpressure

Patella Mobilization to begin as incision heals

Knee Flexion stretch with foot placed on 6-12 inch step and a forward weight shift

STRENGTHING

Continue with Quad sets until able to independently generate quality muscle contraction

Seated hamstring curls

Prone hip extension

Closed Chain exercises only

Leg Press (65-10 degrees)

Step ups (2-4 inches) forward and lateral

Stool Scoots

Mini Wall Squats (0-40 degrees), feet shoulder width with slight external rotation

BALANCE

Box Drill: 5 steps fwd, 5 steps right, 5 steps back, 5 steps left

Single leg balance, level surface – eyes open/closed

You should see Dr. Arnold as instructed 4-6 weeks following surgery. Please call to make or confirm your appointment. You should see your physical therapist on a regular basis as directed by your therapist.



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ACCELERATED REHABILITATION PROTOCOL
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Phase III – Weeks 5 through 9 following surgery

This is the point where most grafts are at their weakest point during this time; therefore proceed with caution with exercises progression/selection

Goals:

1. Protect the reconstruction, avoid falling
2. Maintain full knee extension
3. Attain full knee flexion (140 degrees)
4. Walk with a normal heel-toe gait with no limp
5. Muscle strength and conditioning improvements

Activities:

1. BRACE / CRUTCHES – At this point you should have discontinued the brace and crutches as your knee gains strength and flexibility as shown when you feel confident walking on the operated leg and have good strength and knee motion. Usually this is when you can lift your leg straight up off of a level surface without any bend or lag in your knee. Concentrate on walking with a heel-toe gait without a limp.
2. COLD APPLICATION – continue to use ice as much as needed after your workouts
3. KNEE SUPPORTS – many people feel more comfort with an elastic (neoprene) knee sleeve that can be purchased at a sporting goods store. It should have an opening for the kneecap, but it does not need to have hinges on the side.
4. STATIONARY BICYCLE – continue to use a stationary bike as described in the previous section to improve range of motion and to strengthen your quad muscles.
5. SWIMMING – Swimming may begin at this time using only the flutter kick. The strokes that you may use are the freestyle and the backstroke. **DO NOT** use the breaststroke, butterfly or the sidestroke. Swimming with a kick-board is allowed as long as the flutter kick is used. You may swim 15-20 minutes, 3-4 times a week if desired.

Exercise Program – If full knee extension has been gained and the knee can be held straight with good strength then with the exception of the quad sets, Phase I exercises may be discontinued. You should continue the Phase II exercises as well as adding the following. Your therapist may suggest other exercises or will tailor a specific program for you.

1. CHAIR SQUAT – Set a chair in an open space. Facing away from the chair, and without using your arms, lower your buttocks toward the chair until your buttocks touch the chair. Do Not sit or rest in the chair, but instead immediately and slowly return to the standing and starting position. You should keep your head over your feet and bend at the waist as you descend. After the first week, you may hold light dumbbells while performing this exercise. Complete three sets of 10 to 15 repetitions.
2. WALL SLIDES – Stand upright with your back and buttocks touching a wall. Place your 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 45 degrees. Pause five seconds, and slowly slide up to an upright standing position. Do 3 sets of 10 to 15 repetitions.



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ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION
ACCELERATED REHABILITATION PROTOCOL

Dr. Christopher A. Arnold

(Phase III continued)

3. HAMSTRING STRETCH – Bend slowly forward at the hips keeping the knee fully straight until you feel a *gentle* stretch in the back of your thigh and knee. Do Not bounce. Hold the stretch for 15 to 20 seconds and repeat 3 to 5 times.
4. QUADRICEPS STRETCH– You may do this stretch one of two ways. If you feel comfortable stand with something to support you (i.e. wall, chair, etc), bring your heel to your buttock until you feel a gentle stretch in the affected leg. The other variation is to sit with your leg bent underneath you. Lean back, bring your buttock to your heel. Hold either stretch for 15 to 20 seconds. Repeat 3 to 5 times.
5. CALF STRETCH– Stand with your heel flat on the floor and the knee fully extended. Lean forward at the hips, letting your arms dangle until you feel a gentle stretch in the calf and knee, hold for 15 to 20 seconds. Repeat 3 to 5 times.

DO NOT do any of the following exercises.

1. Knee extension weight machine
2. Running
3. Jumping
4. Pivoting or cutting

Other Suggested Exercises:

STRENGTHING

Progress closed chain exercises

Stairmaster – short strides with emphasis on quadriceps tightening and control

Stationary bike – okay to increase resistance, but emphasize endurance

Resisted walking

Unilateral quarter squat

Step Ups-increase height to 6 inches

Treadmill with emphasis on normal gait

Forward step downs with focus on eccentric control

Toe raises – progress to unilateral

BALANCE

Plyo-toss/rebounder-progress to single leg and unstable surface (wobble board, ½ foam roll, etc) as tolerated

Single leg balance activities, no twisting or pivoting

You should see Dr. Arnold at two months following surgery or as instructed. You may call if you have any problems or questions regarding the exercise program.



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Phase IV – From the 10th week on

Goals:

1. Regain full muscle strength
2. Improve cardiovascular conditioning
3. Sport-specific training

Activities:

1. MUSCLE-STRENGTHENING EXERCISE – You should continue the strengthening exercises from phase II and III on a three times a week basis. At this time, you can decrease the number of repetitions per set from 15 to 10 to allow you to increase the resistance weight. Remember to do all exercises slowly with good form.
2. CARDIOVASCULAR CONDITIONING – You may begin using machine-based equipment such as Nordic track, stationary bicycle, rowing machine or you can continue to swim to enhance your cardiovascular fitness. These exercises should be done three to five times a week for 20 to 30 minutes per workout. Remember to warm up slowly and allow time to cool down afterwards.
3. SPORT SPECIFIC TRAINING – To reach the ultimate goal of returning to sports participation you must follow an orderly sequence of drills which are designed to re-train the muscle-to-joint coordination that is necessary to provide the proper control of your knee. The following timetable illustrates an ideal progression sequence:

Week 10

Begin Bilateral jump downs with emphasis on eccentric control. Land soft “like a feather,” knees should flex to 30 degrees; no “knock knees.” Start from a low height (4”) and increase height as tolerated. Begin slow backward jogging at distances (less than 50’) with emphasis on form-stay low, knees bent, and well balanced. Single leg hop up and down; keep vertical distance small while emphasizing control and form.

Week 11

Begin box jumps up, progress to up and down; bilateral progressing to unilateral with emphasis on quality and control as described in week 10.

Week 12

After being fitted for/and receiving ACL functional brace, begin forward straight line jogging

Week 16

Straight line forward and backward running; begin with slow starts and stops, progress to quick starts and stops. Operate at 50-75% of full speed. Be careful to avoid pain with running. Continue agility exercises, increase speed to 75%

Week 20

Zigzag, figure eight, circle, carioca running

Week 24

Sprints, progress to running full speed
Pivoting and cutting drills

6 Months: Return to sport’s practice when cleared by Dr. Arnold

Your physical therapist will provide you with specific activities and instructions for each step.



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ACCELERATED REHABILITATION PROTOCOL

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Phase V – From the sixth month on, athletes can usually return to running, jumping, and quickly changing direction in sports activities

Goals:

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

Sports Specific Training:

1. PHASES OF TRAINING
 - a. Straight ahead running phase
 - b. Direction change running phase
 - c. Advanced direction change and impact phase
2. PREREQUISITES
 - a. Full Range of Motion to affected leg
 - b. Strength at least 80 % compared to the unaffected knee
 - c. Thigh girth within ½” of the unaffected knee
 - d. No tenderness at the graft harvest site
 - e. Symmetrical quad and hamstring flexibility
 - f. Perform and pass functional test
3. FUNCTIONAL TESTS
 - a. Before starting the running sequence you must be able to:
 - i. Hop forward on both legs at least two feet
 - ii. Hop to either side at least one foot
 - iii. Hop up and down on both feet ten times
 - iv. Jog with no limp for 100 feet
 - b. Before starting the advanced direction change and impact training, you must be able to:
 - i. Hop forward on the affected leg at least 80 % of the distance of the unaffected side.
 - ii. Hop to either side for 80 % of the distance of the unaffected limb
 - iii. Hop up and down on the operated limb ten times with no pain
4. WARM-UP / STRETCHING / ICE – Be careful to be sure that you warm-up and stretch before workouts, and stretch well again after workouts. Generally, you should do some walking, cycling or jogging so you break a sweat before starting running program. You should then stretch before beginning the running drills. Ice your knee for 20 minutes following workouts.



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ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION
ACCELERATED REHABILITATION PROTOCOL

Dr. Christopher A. Arnold

(phase V – Continued)

Training Phases

1. STRAIGHT AHEAD RUNNING – every other day or 3 to 4 times per week

Illustration:

- Day 1: Run $\frac{1}{2}$ speed 100 yards, 10 repetitions
 - Day 2: No Run
 - Day 3: Repeat Day 1
 - Day 4: No Run
 - Day 5: Repeat Day 1
 - Day 6: Run $\frac{3}{4}$ speed 100 yards, 10 repetitions
 - Day 7: No Run
 - Day 8: Repeat Day 6
 - Day 9: No Run
 - Day 10: Repeat Day 6
 - Day 11: No Run
 - Day 12: (1) Run $\frac{1}{2}$ speed 100 yards, 3 repetitions
(2) Run $\frac{3}{4}$ speed 100 yards, 3 repetitions
(3) Run full-speed, 50 yards, 4 repetitions
 - Day 13: No Run
 - Days 14 through 42: Continue workout from day 12, adding one 50 yard run each workout until you can do ten 50 yard full speed runs. This progression should take a minimum of 24 days, but may take longer if pain or swelling occurs. Do Not progress to the next step in progression until the present step is pain free, without swelling.
2. BASIC DIRECTION CHANGE RUNNING:
 - Day 1: Continue 100 yard run, $\frac{1}{2}$ speed, 2 repetitions; $\frac{3}{4}$ speed, 2 repetitions; Full Speed, 2 repetitions
Start zigzag run, round corners, 50 yards, 5 repetitions
 - Day 2: No Run
 - Day 3: Repeat Day 1
 - Day 4: No Run
 - Day 5: Repeat Day 1; Add backward run, 25 yards to gradual stop, then run forwards 25 yards to gradual stop, 5 repetitions
 - Day 6: No Run
 - Day 7: Repeat Day 5
 - Day 8: No Run
 - Day 9: Repeat Day 5; add circle run, 20 foot or greater diameter circle, 3 repetitions to left and 3 repetitions to the right
 - Day 10: No Run
 - Day 11: Repeat Day 9
 - Day 12: No Run
 - Day 13: Repeat Day 9; add five figure eight runs, 20 feet or greater length, 5 repetitions
 - Day 14: No Run
 - Days 15 through 42: Repeat Day 13



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ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION
ACCELERATED REHABILITATION PROTOCOL

Dr. Christopher A. Arnold

(phase V continued)

3. ADVANCED DIRECTION CHANGES AND IMPACT TRAINING
- Day 1: Continue Prior Phase Day 13 as warm up. Add Carioca (Dipsy Doodle Run), 50 yards, 5 repetitions left, 5 repetitions right
- Day 2: No Run
- Day 3: Repeat Day 1
- Day 4: No Run
- Day 5: Repeat Day 1
- Day 6: No Run
- Day 7: Repeat Day 1; Add run forward to plant-and-cut off *unoperated* limb, ½ speed, 5 repetitions. Also add double-leg forward hopping, 3 sets of 5 repetitions.
- Day 8: No Run
- Day 9: Repeat Day 7
- Day 10: No Run
- Day 11: Repeat Day 7
- Day 12: No Run
- Day 13: Repeat Day 7; Add run forward to plant-and-cut off *operated* limb, ½ speed, 5 repetitions. Also add double-leg side-to-side hopping, 3 sets of 5 repetitions to each side
- Days 14-32: Continue to alternate Day 13 with No Run days
- Day 33: Continue all prior exercises increasing to full speed as tolerated. Add single-legged forward hopping, 3 sets of 10 repetitions.
- Days 34-44: Continue to alternate Day 33 with No Run days
- Day 45: Continue Day 33, add single legged side-to-side hops, 3 sets of 5 repetitions to each side
- Days 46-55: Continue to alternate Day 45 with No Run days
- Day 56: Continue Day 45, add run forward 10 yards, then turn on toes to run backward 10 yards. Continue to alternate as described for 50 yards. Repeat 5 times.
- Days 57-66: Continue to alternate day 56 with No Run days.

If you have any questions about your progression you may ask your therapist, or you may always call Dr. Arnold's office (479-966-4187) with any questions.