

Advanced Gait Training

For Above Knee Amputees

Todd Schaffhauser



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Todd Schaffhauser History:

- ❏ Lost leg at age 15 to bone cancer
- ❏ Followed by 18 months of chemotherapy
- ❏ Involved in 6-month research rehabilitation program
- ❏ (ASPIRE PROGRAM)
- ❏ My PT was David Balsley
- ❏ Started competing in September 1986
- ❏ First race 100 m dash, 25.8 seconds
- ❏ Started Training For 1988 Paralympics



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1988 Seoul Paralympics:

- ❏ Gold Medal in 100 meter dash: 15.77 seconds
- ❏ 2nd person ever to run under 16 seconds for 100 meters
- ❏ First to do it running leg over leg
- ❏ 14.55 seconds 100 meter



Programs:

- ☞ Began training amputees in 1989
- ☞ Two formats
- ☞ Full day clinic
- ☞ Amputee Walking School

Attendees:

- ☞ Seasoned amputees
- ☞ Amputees just finishing outpatient rehab
- ☞ Physical Therapists, PTA's & PT students



Goals:

- Teach strength training exercises
- Prosthetic control exercises
- Cardio Conditioning
- Proper running gait for above knee amputees



AK Training Series:




- ❏ A sequence of exercises to improve strength and prosthetic knee control
- ❏ Hamstrings
- ❏ Hip Extensors
- ❏ Quadriceps
- ❏ Hip Flexors
- ❏ Abductors
- ❏ Adductors








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Findings:

Many above knee amputees who have:

-  **Weak hamstring**
-  **Weak hip extensors**
-  **Never use those muscle groups to stabilize prosthetic knee**

This leads to:

-  **Poor knee control**
-  **Need for more stance control**
-  **Lesser functional ability**
-  **Lesser confidence in prosthesis**
-  **Smaller selection of prosthetic knees that can be prescribed**



AK Training Series:

- ❏ These next sets of exercises are meant to build strength in the residual limb, hip extensors, and hip flexors.
- ❏ They will also increase your proprioception (where your leg is in space) after some time practicing.
- ❏ These exercises can be done with a temporary prosthesis (free swing) or with a permanent one.
- ❏ If you have a SNS Hydraulic Knee, turn off the stance phase by putting your prosthesis behind you, Stepping on the toe, and pull up the stance phase lever.



AK Training Series:

- ☞ You will also find out if your leg has a good form of suspension (suction) while doing some of these exercises.
- ☞ These exercises require some forceful movements of the hip.
- ☞ A full range of motion of the hip is critical to good form.
- ☞ The final goal is to increase control (awareness) of where your prosthesis is in gait training.



AK Training Series:

1st Round:

- ☞ Test Strength
- ☞ Leg Swings
- ☞ Heel Strikes
- ☞ Grid Work
- ☞ Baby Steps
- ☞ Odd Steps
- ☞ Step Ups

2nd Round:

- ☞ Heel Strikes advanced
- ☞ Power Walk
- ☞ Rebounder
- ☞ Balance Beam
- ☞ Lunges
- ☞ Squats/Sitting in a chair
- ☞ Fast timed walk



Test Strength

Personal observations of varying degrees:



- 📄 **Hip Extensor/Hamstring**
- 📄 Have amputee lift prosthesis up as high as they can
- 📄 Place hand on the back of the socket
- 📄 Have them push down and try to drive heel into the floor

- 📄 **Hip Flexor/Quadriceps**
- 📄 Bend prosthetic knee from behind and grab at ankle
- 📄 Have amputee push forward
- 📄 Spotter release hold at the ankle once they give good push to see if leg goes into full extension



Resistance Test:

Knee Extension:



- ☞ Hold back of knee
- ☞ To resist amputee
- ☞ Pulling into full extension

Knee Flexion:



- ☞ Place hand in front of knee
- ☞ To resist amputee
- ☞ Pushing into knee flexion

Resistance Test:

Knee Extension:

Knee Flexion:



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Leg Swings:

- ❏ You may need to use a spotter, a wall, or the parallel bars as a form of balance support.
- ❏ You may also need to stand on a 2-4 inch step on the side you are not working for clearance of the floor.
- ❏ You are going to concentrate on developing a full swing range of motion of the knee and hip.
- ❏ So begin swinging your leg backwards, then forwards in an arc like a pendulum motion.



Leg Swings:

- ❏ Building up the intensity of the swing requires a stronger push on the front and back walls of socket.
- ❏ The feeling is kind of like you want to throw your leg off.
- ❏ But of course you won't,
AT LEAST WE HOPE.
- ❏ If that happens, get back in to see your prosthesis and get a better form of suspension.



Leg Swings:

Start:



Finish:



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Leg Swings:

Leg Swings:



Leg Swings
Assisting:



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Leg Swings Assisting:

- ❏ A physical therapist can help you perfect this movement by standing on the side of you, placing their hands on the socket (avoid placing your hands in the knee joint) and gently giving a push backwards and forwards.
- ❏ This will help you to achieve the full range of motion you are capable of as well as giving those quadriceps, hamstrings, and hip a little help.
- ❏ After some practice you'll be doing this on your own.



Leg Swings:

- As a beginner this exercise will fatigue the muscles in the hip and residual limb very quickly.
- BEGINNER GOAL:** 3 sets of 5
- INTERMEDIATE GOAL:** 3 sets of 12
- ADVANCED GOAL:** 3 sets of 25



Heel Strikes:

- ❏ This exercise will help you to develop where your foot is in space without having to always look down.
- ❏ Stand in between the parallel bars with the prosthetic foot behind you and begin to flex your hip/push on front wall of the socket and start moving your leg into swing phase.
- ❏ About half way through the swing phase motion stop pushing on the front part of the socket and make an aggressive push on the back wall of the socket.



Heel Strikes:

- ❏ By pushing on the back wall of the socket you activated your hip extensors and hamstrings to bring the prosthesis back down to the ground.
- ❏ The overall idea is to drive your heel down into the ground in whatever spot you want.
- ❏ Remember it is an aggressive push on the back wall of the socket activating those hip extensors, which after typically weak post amputation.



Heel Strikes:

Start:

Finish:



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What to watch for:

- ☞ Are they striking or floating the leg
- ☞ Are they leaning back
- ☞ Are they sitting back
- ☞ Are they shifting weight to the prosthetic side
- ☞ Are they able to bend the knee (what knee unit is it?)
- ☞ Does the knee buckle at point of heel strike
- ☞ Does the leg rotate too much (internal or external)



Heel Strikes Assisting:

- Physical therapists can assist the movement by placing their hands on the socket; avoid the knee hinge, and aggressively push backwards to assist the hip extensors in striking the ground.
- Do this with someone who has weak extensors or a real lack of control



Heel Strikes:

- 📄 BEGINNER GOAL: 3 sets of 5
- 📄 INTERMEDIATE GOAL: 3 Sets of 12
- 📄 ADVANCED GOAL: 4 sets of 15
- 📄 As a beginner, this exercise will fatigue the muscles in the hip and residual limb very quickly.

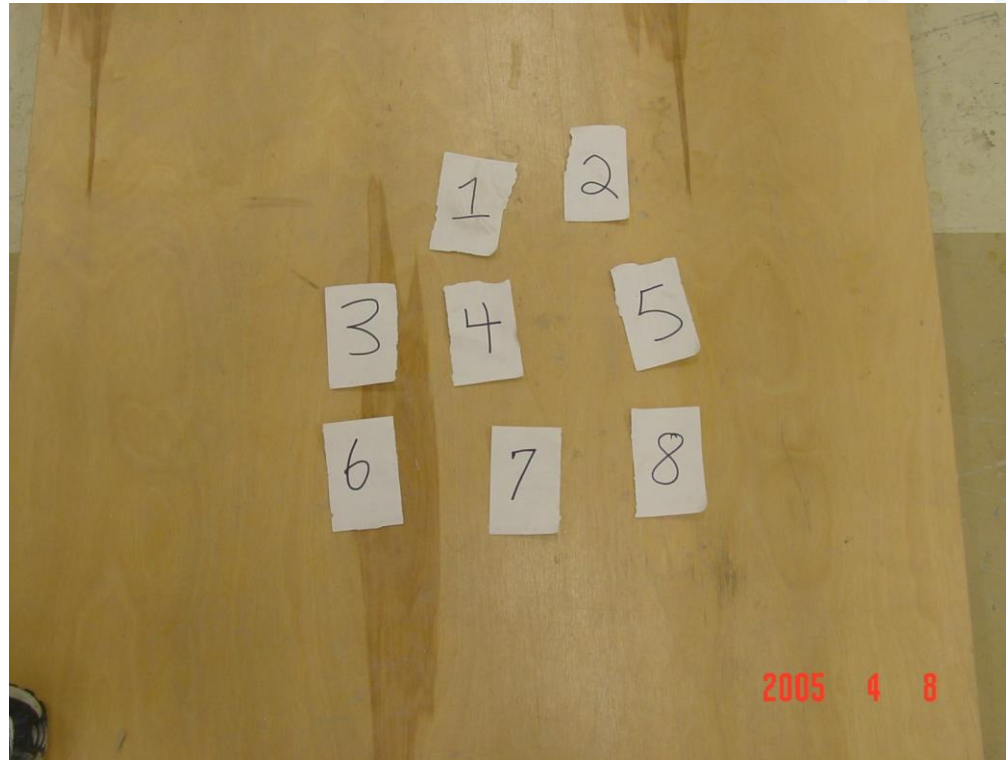


Grid Work:

- ☞ This exercise has been called a "targeting" one.
- ☞ Take pieces of masking tape and place them on the ground in front of you and to the sides of you.
- ☞ Create a marker to stand on with the sound side.
- ☞ Make the pieces of tape big for beginners.
- ☞ The physical therapist will now number each piece of tape 1 to however many are on the floor.
- ☞ They then will call out each number in order as you go through the grid performing the Heel Strike exercise.
- ☞ After becoming more advanced, call the numbers out of order and eventually make the markers on the floor smaller and smaller to further increase proprioception.

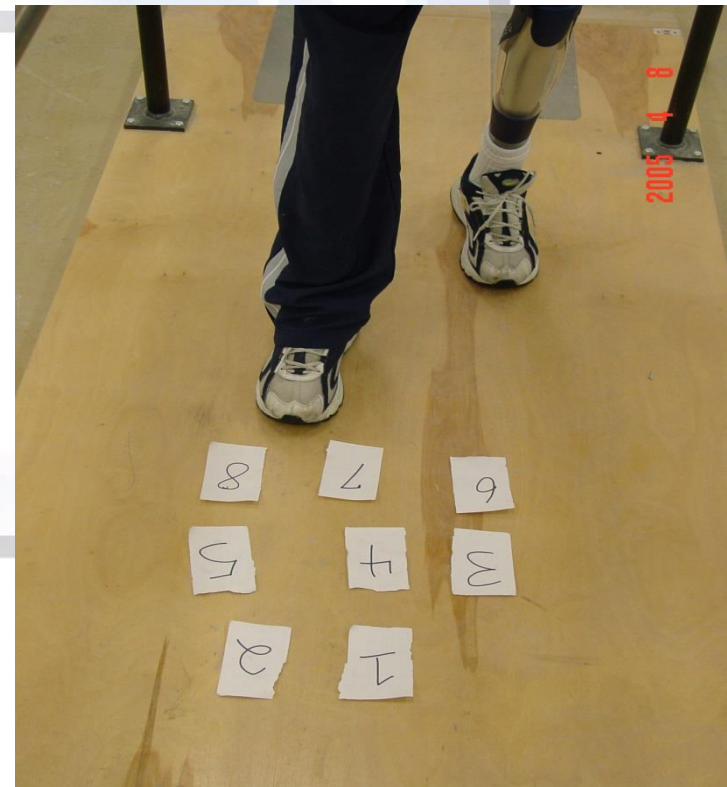
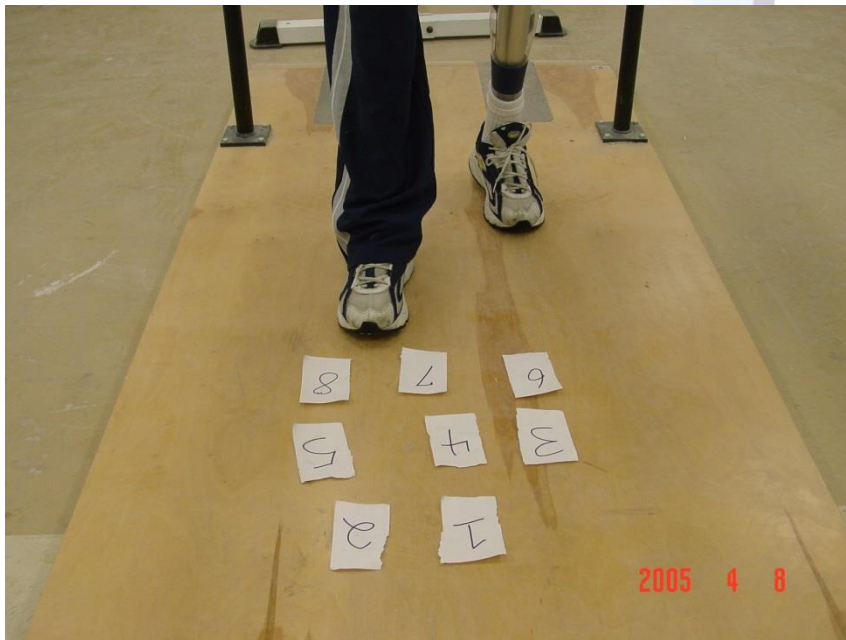


Setting Up A Grid:



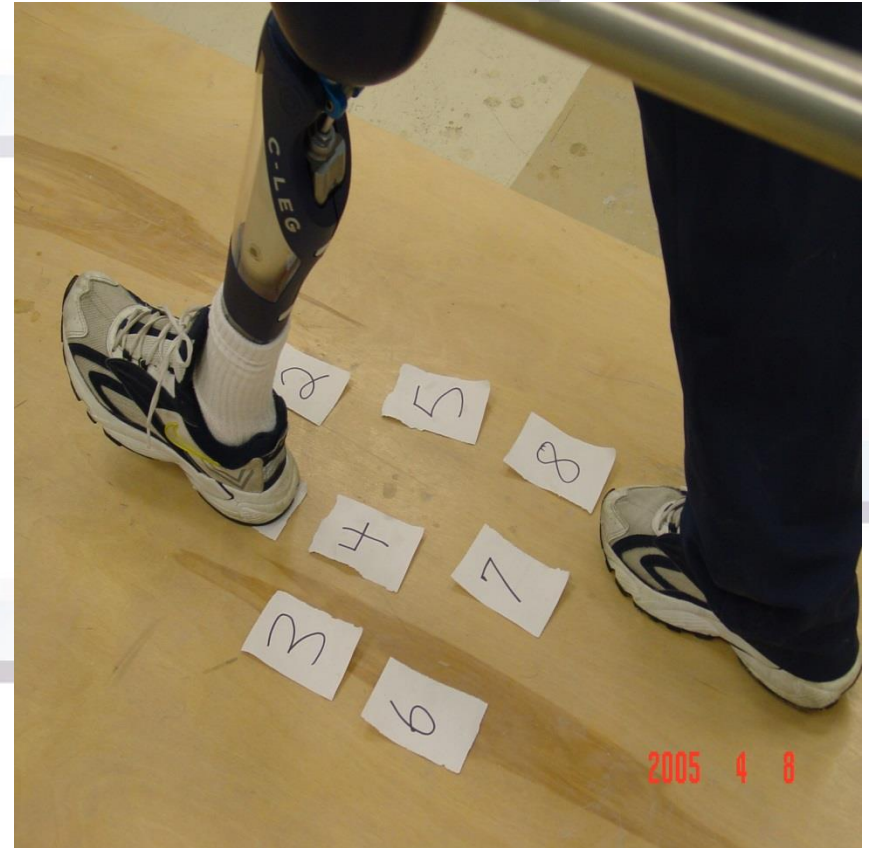
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Prosthesis is the Back Leg:



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Grid Work Finish:

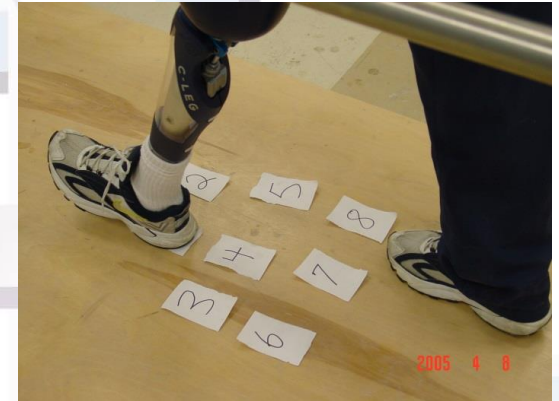


☞ You want to transfer your weight onto prosthetic side



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Transferring your weight onto prosthetic side:



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Baby Steps:

- ☞ This exercise will help get rid of some bad habits like vaulting (rising up too much on the sound side). We start to introduce heel striking from the grid to an actual part of walking.
- ☞ By taking small "baby" steps in the length of the parallel bars, practice a continuous heel strike exercise.
- ☞ Taking those small steps with both the prosthetic side and the sound side will not allow the vaulting action to take place.



What to Watch for:

- ❏ Are they vaulting
- ❏ Are they circumducting
- ❏ Are they floating
- ❏ Are they bending the knee (they must bend the knee to achieve proper movement)



Baby Steps:

- Physical therapists can again assist by standing on the side and putting their hand on the socket area and push backwards to assist the hip extensors and hamstrings in achieving a quick heel strike.



Baby Step Goals:

Measuring out a 10 ft. distance:

- ❏ Beginners will complete 3-5 baby steps for every 5 ft.
- ❏ Intermediate levels will complete 5-10 baby steps for every 5 ft.
- ❏ Advanced will complete 10-15 baby steps for every 5 ft.



Odd Steps:



- ❏ This one will increase your stance time while walking on your prosthesis and force the knee to have to bend.
- ❏ Take a short step with your prosthesis and a long step with you sound leg.
- ❏ Do the opposite: a short step with the sound limb and a long step with the prosthesis.



Step Up:

- ❏ Place your prosthesis on a short step.
- ❏ Try using a Reebok step in between the parallel bars or a stairwell with handrails.
- ❏ Push really hard on the back wall of the socket to force the leg into full extension.
- ❏ This is teaching someone to lead with their prosthetic leg.
- ❏ If the person does not have the strength in the extensor muscles to push back, the prosthesis will buckle.



Step Up:

Start

Finish



Push on back wall of socket



Other foot comes up to be equal to prosthetic side



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What to Watch for:

- ☞ Are they using the other leg to push up/jump up?
- ☞ Is the knee ending in full extension or is it slightly bent or buckling?
- ☞ Do they need a lot of assistance from spotter?
- ☞ Are they in the end position have both feet are equal or is the sound side slightly behind?



Step Up Assisting:

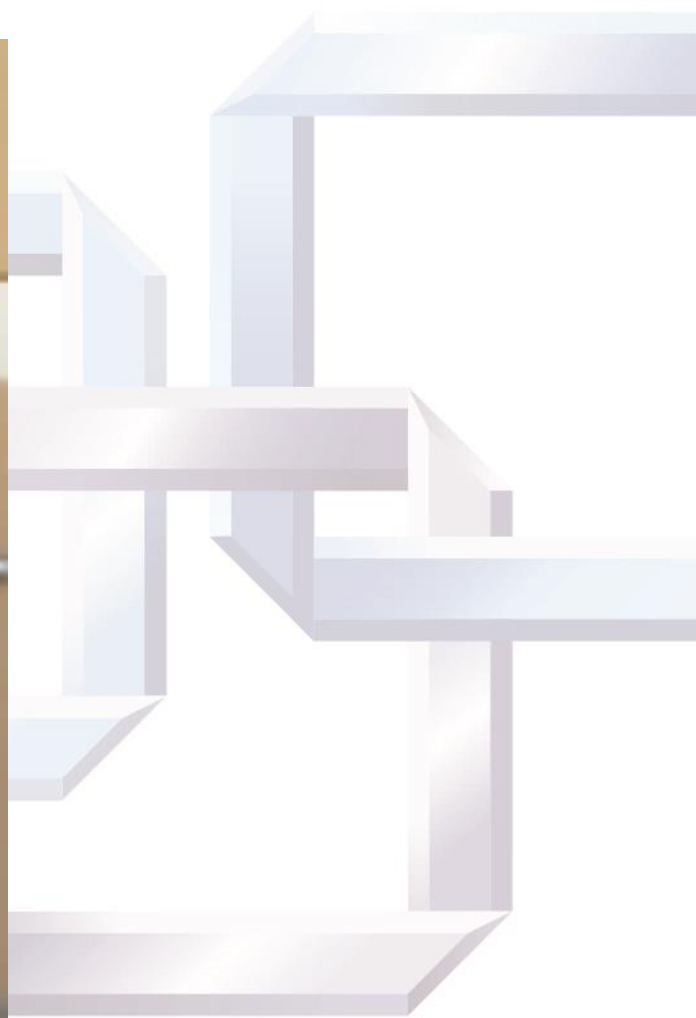
- Spotting is very important for beginners.
- This will help build strength for escalating stairs and curbs
- A physical therapist can help in two ways:
 - One way is to push cradle backwards and the socket forward to assist the extensors.
 - Another method would be to hold the prosthetic foot that is on the step from turning side to side.
- This side to side motion is happening because the AK amputee is not putting enough weight on the prosthesis.
- By holding the foot, you are giving them security in only having to control the prosthesis with the hip extensors and hamstrings.



Step Up Goals:

- ❏ Beginners: Can usually accomplish a 2-4 inch step with assistance
- ❏ Intermediate: 4-8 inch step; moderate to no assistance
- ❏ Advanced: 12 inches and above with no assistance





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Heel Strikes On Different Surfaces:



Balance Discs, Steps and Balance Pads



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Walking Up and Over:

Step On



Step Over



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Step Over



- Start with one inside parallel bars
- I work up to 4 to 6 inside parallel bars
- Increasing the amount of rollers works on stepping over and limits space in between to plant feet



Balance Beam



TOP VIEW
Split middle allows
folding for storage



8ft long x 4in wide and
1 inch high*
Poly Balance Beam

*Approximate measurement



BOTTOM VIEW
Solid construction



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Power Walking With Thera-band:

- ❏ Spotter wraps t-band around AK side (midway length of residual limb), and holds from behind as amputee powers through walking gait.
- ❏ Use heavy resistance t-bands.
- ❏ When the bands come off, the AK amputee will feel like the prosthesis is super light and now be able to walk much quicker and stronger.
- ❏ One important note is that you want to make sure the person is bending the knee on the prosthesis side while the t-band is attached.



Power Walk Goals:



- 📄 Beginners: Start inside parallel bars (10 Ft.)
- 📄 Intermediate: Turn around and walk back (20 Ft.)
- 📄 Advanced: Work up to 50 Ft., adding 10 Ft. more at a time



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Rebounder:

- ☞ This is heel striking into mat
- ☞ Hit center of mat
- ☞ Set up grid work
- ☞ Make sure they shift weight onto prosthetic side after striking it
- ☞ The feeling is like trying to push into the mat
- ☞ Work sound side too, but not by striking it, just stepping onto mat



Test of Weight Shift:

- ❏ After amputee hits mat with heel strike, have them hold position for 5 seconds
- ❏ Spotter try and move prosthetic side in all different directions
- ❏ If the foot moves then they are not shifting enough weight and holding the shift onto mat
- ❏ Are they leaning back?



Lunges:

- With spotter in the front, the amputee will step out with prosthesis then bend the knee until the foot is flat on the ground and hold

Ways to evaluate and set goals:

- Distance: from the toes of the back foot to the heel of the front foot that we can measure
- 4 inches for a beginner
- 8 inches for an intermediate
- 12 inches higher for advanced



Sitting in a Chair and Squats:

- Have the amputee sit in a chair
- Do they collapse into the chair?
- Do they lift prosthesis off the ground
- to sit in the chair?

Recommended 3 exercises:

- Total Gym Squats
- Leg Press machine
- Squatting using ball

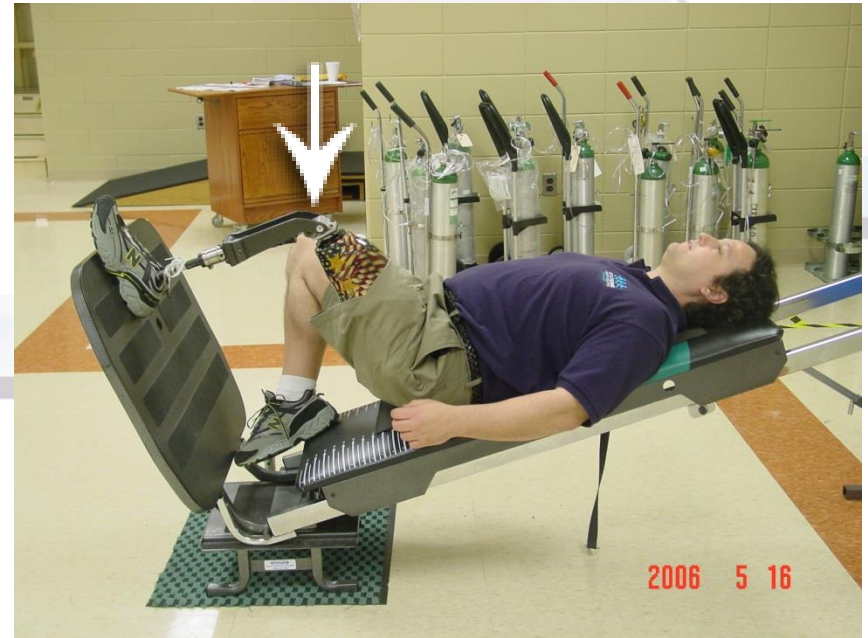


One Leg Squat:

Start:



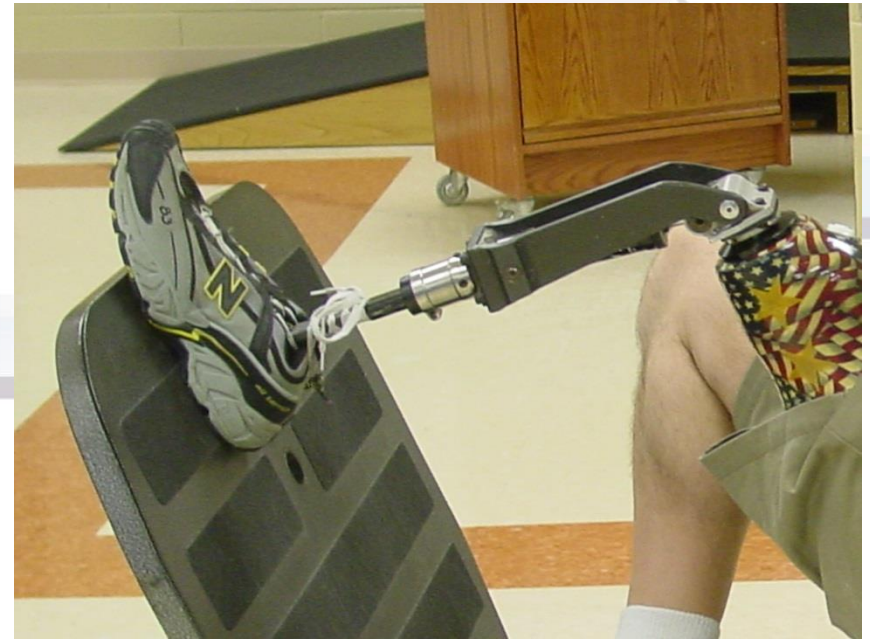
Finish:



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One Leg Squat Foot Position:

- ❏ Amputee's foot is positioned about half way off the front of the squat stand
- ❏ This allows amputee to squat down into 90 degree angle



One Leg Squat:



- ❏ Slowly guide amputee down to finish position
- ❏ If they need help, assist by pushing knee back into full extension



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Fast Walk Timed Sets:

- 📄 A good test and great workout
- 📄 The right candidates/ A very advanced workout
- 📄 Have amputee walk as fast as they can
- 📄 NOT ON TREADMILL
- 📄 Tests prosthetic control
- 📄 Reinforces “Push & Pull” socket training
- 📄 Mark out distance of 50 feet

- 📄 Just over 20 seconds beginner
- 📄 Just over 15 second for intermediate
- 📄 Just over 10 seconds for advanced



Questions?



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