Guidelines for Using the AlterG

Patients with Neurological Problems

by Nancy Byl, PhD, PT

PURPOSE

The goal of training patients to walk on the AlterG treadmill with lower body positive pressure unweighting (LBPP) is to generally support the ability of patients to walk despite impairments. More specifically, LBPP can be used to enable patients to:

1. Progressively weight the lower limbs post injury in order to increase oxygenation and healing
2. Bear weight on the lower limbs (including stepping in place and walking) to maintain bone mineralization when a patient does not have sufficient strength to stand or walk over ground
3. Develop a normal pattern of gait
4. Increase walking efficiency (speed and step length)
5. Improve balance and postural reactions to protect against falls
6. Improve coordination by skipping (1.0-2.5 mph)
7. Enhance range of motion at the hip, knee and ankle with squatting (about 20% unweighted)
8. Exercise at an aerobic level (fast walking or jogging) without excessively overloading degenerative or injured joints (spine, knees and hip)
9. Increase cardiopulmonary and musculoskeletal endurance
10. Improve competitive performance in running
11. Increase strength of the lower limbs
12. Improve ability to do two tasks simultaneously
13. Improve gross motor coordination of upper limbs while walking/jogging

SETTINGS

Height of Support

The height of the support should be adjusted based on patient height. Sometimes the proportionality of trunk length and leg length can alter the usual settings. The settings (front and back) are used to allow for comfort and safety. Adjustments should allow for a neutral position which means that the user is not leaning forward or backward. The patient must be lined up over their base of support and should not rely on bars for support. These recommendations must be adjusted to each individual to suit their unique biomechanics. Thus, the chart appearing below (for the AlterG P200 model) can only be considered a guide. Realistically speaking, a 4' 8" person is probably the shortest individual that can properly wear the shorts. Patients with excessive trunk and leg weakness may be required to wear the shorts higher providing air distributed support higher on the trunk. In addition, a tall, unstable patient may also need the extra support bars to be placed just below hip level allowing the patient to hold on. Further, the bars can be used to help the patient step on and off the treadmill safely. *(See Table 1)*

Table 1 - Height of Support

Height	Level	
	Front	Back
4'8"	2	1
4'9" - 5'2"	3	1
5'3" - 5'6"	4	2
5'7" - 5'9"	5 or 6	3 or 4
5'10" - 5'11"	6	4
6'0" - 6'2"	6 or 7	4 or 5
6'3" - 6'4"	7 or 8	5 or 6

As a general guideline, the setting in front will usually be consistent with height (in feet) and the setting in back will be 1-2 levels lower. If the user is forced forward (forward lean), then a higher setting in front and a lower setting in back are needed. If the user is leaning back, then settings should be higher in back and lower in front.

MONITORING DURING EXERCISE

For those 50 years of age or older, oxygen and heart rate should be monitored during exercise. This can be done with an oximeter or a polar chest monitor. If the patient has a heart condition or some other systemic or neurodegenerative condition that may affect the regularity of the heart beat or alter the autonomic nervous system responses, then blood pressure may also need to be monitored. If the patient has had a frank heart insult, telemetry may need to be used. In general, oximeter readings should be taken at baseline, then at the end of the warm up, throughout the aerobic phase and at the cool down phase. If the patient has a heart condition, monitoring should be more frequent (e.g. every 5 minutes). To estimate the aerobic heart rate, subtract the patient's age from 220 and then multiply by .7 and then .8 to calculate 70-80% heart rate threshold. It is also a good idea to have the patient cleared by their physician to participate in aerobic exercise. If there are other medical concerns, ask the physician to specify limits in aerobic and musculoskeletal exercises.

UNWEIGHTING

Unweighting a client on the AlterG is not a science. The shorts should fit tightly to allow for proper air tight sealing but should still be comfortable. Thus, better to have the shorts tighter than looser if the goal is to unweight more than 50%. The patient may need

(continued on back)

UNWEIGHTING *(cont.)*
assistance putting on the shorts, particularly if they have some involvement of the upper limbs.

If a patient has an acute condition, it is recommended that there be increased unweighting. If the patient has recently been cleared to exercise post fracture or injury, it is best to start at 40-50% of body weight. When patients are in the fair range of strength, or they have motor control problems, it is best to start with 40-50% of their body weight. If the weakness involves the trunk, putting the bag level higher on the trunk can add more support. However, be careful that the back of the bag is lower so it does not push the patient forward.

If the patient has a neurodegenerative disease, the goal is to maintain independence and mobility despite the impairment. In these cases, the goal is to unweight the patient to the level where walking is the best and the safest gait parameters are used (e.g. the patient takes a long stride and has good heel strike). When there is a motor control problem, an aerobic level may be achieved at a fast walk or jogging slowly. It is important to note that the goal is not necessarily to decrease the patient's weight over time. Instead the ideal weight at which performance is highest should be maintained. This guideline for unweighting would also be true for a patient with severe degenerative arthritis. It is unrealistic to increase weighting to 100% (as this is the condition of the usual environment). The advantage is the unweighting and protection against falling. When worried about falling, all of the wrong reflexes are recruited and patients almost work against maintenance of healthy gait.

On the other hand, with a healing musculoskeletal injury, the goal would be to unweight during healing and slowly progress to normal weight to enhance an effective return to normal running or sports. The progression of weighting would have to be balanced by pain, length of time post injury, the ability to walk or jog/run normally and the degree of pain during and after exercise.

Weighting the client at the end of the workout should be done incrementally. Do not abruptly go from 50% to 100% and end the session. It is best to decrease the speed of walking while slowly reweighting the patient. Some patients may have significant medical problems and a quick change in weighting and unweighting might lead to lightheadedness or even edema in the feet and ankles.

ASSISTANCE INTO THE ALTERG
For those who are not independently mobile, the Guldmann harness can lift patients safely into and be worn inside the AlterG. For remaining populations, it is recommended that the assistant grasp the shorts to stabilize the patient as they step onto the treadmill platform. It's highly recommended that the administrator also stabilizes the bag (which can shift under one's weight) with a sturdy foot. Patients should be directed to step on the treadmill platform avoiding the edge which can be slippery. The proper settings should be applied and the patient zipped in.

If patients have severe weakness of the trunk and lower limb (e.g. poor to Fair minus), it may be necessary to use some type of harness to assist getting the patient into the treadmill. The Guldmann harness System can actually act like a hoyer lift, getting patients up to their feet and then giving as much unweighting as necessary to step up and into the bag. It is

ASSISTANCE INTO THE ALTERG *(cont.)*
important to give some weight back to the patient when beginning to train to walk. First have the patient step back and forth with the treadmill not moving. Then try to have the patient kick the leg straight. Also try to have the patient partially squat and stand. Make sure there is enough weight that the patient can be weighted and the machine calibrated. Keep the harness attached to prevent collapse when the bag is deflated at the end of the treatment. When you give the patient a break, stop the movement of the treadmill but do not deflate the bag so the patient is still supported but not walking. These patients will usually be able to step when the treadmill is about 0.5 - 0.8 mph.

WARM UP PHASE
The warm up can sometimes be done over ground before donning the exercise shorts. For those who are ambulatory, walking with a high step and a large arm swing can sufficiently account for a proper warm up. Adding ankle and arm weights can further enhance the efficiency of the warm up. However, if the patient has a neurological or orthopedic problem, they may need to warm up on the treadmill after they are partially unweighted.

The warm up phase on the AlterG should occur with the patient unweighted. In this phase, unweighting 50-60% is usually comfortable. Have the client stretch the heel cords, jump up and down 20 times (emphasizing impact with a flat foot) and then briefly stretch the heel cords again. Then have the patient practice a full squat trying to keep the heel flat on the ground. If only unweighted 20%, it may be necessary to increase the unweighting to help the patient stand back up. With the patient unweighting to 40-50%, try to have the patient bend both knees and then jump. If they can do this, try to make multiple jumps.

Then start the treadmill slowly (0.5 - 1.0 mph). Try to teach the patient to skip (step, hop, step, hop emphasizing initial foot flat then roll off toes). Then increase speed to between 1.5 mph and 2.2 mph. Long step, heel strike. As the patient improves, increase belt speed up to 3.0 mph. Patient should increase the stride length and the heel strike. This progression from skipping to walking and ultimately jogging is fun and provides good reciprocal motion where coordination is practiced. When walking at a lower speed, ask the client to grip a Theraband (bilateral) and concentrate on trunk rotation and arm movements (5 minutes). The warm up speed should be adjusted for patients that have a neurodegenerative condition as low as 1.5mph to 2.5 mph.

It may be helpful to determine how much unweighting is required for the client to balance on one foot for 10 seconds (eyes open and eyes closed). This practice can give the patient confidence. You can progressively increase the weight to improve balance. If part of the balance problem is that the gastrosoleus is weak, in this phase, it is beneficial to have the client rise up and down on the toes. First start with both feet together and then one foot at a time. You can also wait to do this at the end of the session.

During this warm up phase it is important to work with the client to maximize their center of support and the pattern of their gait. Think "light on the feet". Concentrate on hitting the heel first with the toes up and then the foot should move to the fully loaded, flat position. Then the heel rises as the client pushes off and then rolls off of the forefoot to quickly begin hip and knee flexion again with the foot dorsi flexed. When the heel rises, there must be good flexion of the hip and knee to clear the foot.

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WARM UP PHASE *(cont.)*
This is critical if there is weakness in dorsi flexion. Try to keep the patient from slapping the foot down.

AEROBIC PHASE
After the warm up phase, the user should be transitioned into the aerobic phase by increasing belt speed until the client is jogging. Most will begin to jog at 3.5 mph. Patients who run regularly or jog regularly on the treadmill may not jog until 4.5 mph. As the patient uses the AlterG, they become more conditioned and do not begin to jog until 4.5- 5.0 mph. Leg length will also impact jogging speed. This speed will also increase over time as the user is able to produce a longer stride length. Ideally patients should jog for 30 minutes continuously. It may be necessary to start with 5 minute intervals and rest for 5 minutes. As you increase the number of 5 minute intervals, increase to 7-10 minute, then rest. Continue to increase time over 2-4 sessions.

COOL DOWN PHASE
Returning body weight should occur gradually at a reduced speed. The cool down phase on the AlterG ideally lasts for at least 5 minutes. Heart rate and oxygen should be measured at least once during this phase. For patients who have a heart condition or other systemic or neurodegenerative condition, the cool down phase should be extended. No patient should immediately sit down directly after aerobic exercise as the heart requires a gradual transition to a healthy resting rate. Patients should immediately transition to over ground walking emphasizing coordinated movements emphasized on the AlterG (long stride, good hip and knee flexion, strong heel strikes, a powerful push off and big arm swings).

SUPPORTIVE DEVICES
Musculoskeletal conditions
If the user experiences lower back pain or sciatica an SI belt should be worn around the sacrum and the pelvis. This will help stabilize the SI joint. A client could also wear a lumbosacral support. If sciatica is an issue, the client might benefit from applying a wrap around the high thigh area which may help prevent the thigh muscles from creating a strain on the sciatic nerve.

If the user has a history of knee pain, either due to degenerative arthritis or an injury, it is possible to wear a knee brace in the AlterG. It is especially easy to wear a Chopat chondromalacia band. This is used under the patella and holds the patella high. The client should not wear a wrap that compresses the patella down against the femur (knee cap). Sometimes, patients wear a supportive metal brace, which makes it difficult to run. In these cases it would be important to start with paced walking rather than jogging or running. It might be helpful to unweight the patient more rather than less to minimize the strain on the knee.

If the patient pronates the foot when walking, it can be helpful to create a temporary orthotic to correct the hind foot (medial wedge). If the client inverts excessively (turns the foot inward), it can be helpful to place a lateral wedge on the mid/forefoot which "brings the floor to the foot sooner". It can also be helpful to use Theraband around the calf and tie to the shoe strings and back up around the calf to try to assist the patient in bring the foot into dorsi flexion and emphasizing heel strike.

SUPPORTIVE DEVICES *(cont.)*
Neurological conditions
If a patient has weak gastrocnemius muscles or weak dorsi flexion muscles, it may be necessary to wear an ankle foot orthosis to help keep the foot in neutral while walking. These clients may need some assistance with stepping, thus, it is best to use the AlterG with the portholes (the P200 model). If patients have very weak hip flexors, it may be necessary to assist the swing phase. It may be helpful to tie Theraband to the shoe lace (of the affected foot) allowing the therapist to pull the leg through the swing phase. If the client tends to lean too far forward in the AlterG as well as over ground, a mirror should be placed above the control box. This method acts as a visual tool cuing the patient to produce and maintain a neutral position. If the patient experiences poor sensation in the feet and legs, visual feedback is helpful. A camera can be mounted to the side of the AlterG projecting images on a laptop computer for the patient to observe.

DUAL TASKING
Participants should be mentally stimulated and challenged during the aerobic phase. Mental tasks should be coupled with throwing and catching or other physical challenges. Examples of mental tasks are lateral thinking problems, mental computation problems, sequencing (counting backwards, spelling backwards), annunciating, spelling and defining and using vocabulary words. To improve memory, repeat material that has stumped the patient in past and assist with tools for remembering challenging material. The administrator should be as creative and engaging as possible to keep the activities fun and allow for progression in difficulty. Usage of other tools such as Brain Warp and Bop It are beneficial as well. It is imperative to reinforce proper cuing for quality gait and proper movement patterns during dual task training.

BALANCE TRAINING
A series of exercises can be conducted on the AlterG to increase proprioception, body awareness and balance. These activities include running with eyes closed and head turning, running with arms up and volleyball sets (patient hits the ball twice). During throwing and catching, challenge the patient by arching the ball at different angles and requiring the patient to reach, juggle two balls or visually track the ball. Balance training can also include standing on one foot and walking backwards.

About Nancy Byl
Nancy Byl is a physical therapist who cares for patients in the physical therapy clinic at UCSF Medical Center. Byl is Professor and Chair of the Department of Physical Therapy and Rehabilitation Science in the School of Medicine, Co-Director of the Graduate Programs in Physical Therapy and Administrative Director of the Peter Ostwald Health Program for Performing Artists.

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