# Injury Prevention for the Blind: Specifically Focusing on Lower Extremity Injuries

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## May 9, 2024

“With the youngest of the baby boomers hitting 65 by 2029, the number of people with visual impairment or blindness in the United States is expected to double to more than 8 million by 2050, according to projections based on the most recent censussss data and from studies funded by the National Eye Institute, part of the National Institutes of Health.” (Varma, 2016) These people could have a long life with good vision or enough vision to complete daily tasks without needing blindness skills including Assistive technology training, braille training, and Orientation and Mobility training. The people who have had total vision loss will have to receive this blind skill training so they will be able to live productive and successful independent lives. A person who is blind or goes blind will need Orientation and Mobility training to learn a safe and reliable way to get around. This is when a person is more likely to injure themselves while learning mobility training and being blind or has vision that dramatically effects being able to tell ground changes. Orientation and Mobility training teaches a blind person proper white cane technique, where the tip of the cane needs to reach past their right side and left side. This is to protect and allow the blind person to see any ground changes with the cane. Very often a blind person will not allow the tip of the cane to reach past their body and this is where they will not be able to catch the edge of a curb or obstacle next to them. Proper cane technique is especially important to use to prevent missing the edge of an obstacle or curb. A blind person who works with a guide dog does not have the ability to see the ground anymore with the dog doing all the work. This unfortunately may cause more injuries when the dog is going around the obstacle and the blind person slips off a curb that they did not notice. Even though this is more likely to happen with a guide dog many blind people prefer independence and smoother, faster mobility with a dog.

When a young person goes blind, they start to develop unhealthy habits and can produce over correction posture. It has been proven that “spatial representation is delayed or dramatically weakened without visual calibration over the haptic and auditory modalities early in life.” (Casado-Palacios et al., 2023) People who may go blind later in life whether in their adolescent years, adult, or senior years will also over adapt for safety concerns but most of the time will not be comfortable with learning what they need to learn with independent blind skills. This is easier to adapt to blindness when it is developed in the younger population but as a person gets older, they will have increased difficulty adapting to the blind skills. At an early age when a child becomes blind, they have no visual reference to learn about the world around them and have no way to learn how or where to move. This also includes how to move their limbs from one location to another smoothly. As this child with blindness grows up, they may take longer to walk than a child with sight due to their parents holding them a lot more and not having the visual reference of where to place their feet while learning. It has been evaluated that “Reductions in spatiotemporal and range of motion are likely linked to a more hesitant stepping pattern due to unfamiliarity with the environment.” (Bennett et al., 2020) This can lead to balance issues with the wrong development of muscles, lack of strength in those muscles to hold the child up for balance, or even the lack of depth perception causing minor injuries from landing too hard on a lower limb. “The consequence of having lack of visual interpretation for the blind even with familiar surroundings, the blind person has a shorter stride length and heavier landing step which causes a higher likelihood to get injuries to the lower extremities.” (Karami et al., 2020)

Lower extremity injuries are a given in the blind population. Many times, Lateral and medial ankle sprains happen and can include the deltoid ligament complex on the inside of the ankle and the lateral collateral ligaments on the outside of the ankle. There is another type of ankle sprain that may not be common in the blind population but may be a possibility depending on the walking surface they are walking on when they fall. A high ankle sprain can include the anterior inferior tibiofibular ligament; this is found in front of the tibia and fibula and the posterior inferior tibiofibular ligament; this is found behind the tibia and fibula. Over time without these injuries given proper rehabilitation it will cause weakness and instability in the ankle joint and lower leg. When this injury happens young, and does not have treatment to strengthen the ankle the blind person will start to make compensations, and this will cause more issues with walking imbalance. When this injury happens in the older blind population this can lead more into a fracture of the ankle joint of the lower leg bones. The more severe the sprain the more likely hood for the fracture of the tibia and fibula. Ankle sprains effect the blind population with all ages and all levels of mobility. Orientation and Mobility training can prevent these kinds of injuries when the white cane technique is perfected. Orientation and Mobility Instructors are the people who can incorporate diverse types of exercises within their mobility lessons. Once these exercises are learned they can be used by the person themselves without supervision. This is not a total prevention method because of the likelihood of getting tired or other human error that can happen during walking. There are no current screening tools for how often or how severe an ankle sprain happens in the blind population with daily life. Just from my subjective experiences this can happen frequently with unstable ground where lack of depth perception hinders the ability to adjust to those changes quickly and safely. I have found many articles where exercise has been suggested to be a good thing for the blind population but have not found any that have specifically focused on preventing lower leg injuries for the blind population.

In some studies, it has been reported that a moderate self-report of falls happens in the blind population from young adult to older adult. (Gashaw et al., 2020) This article will be covering how to strengthen, increase balance, and increase flexibility to decrease the extreme of an injury to the lower extremity. The benefit of having these exercising techniques would be so that a blind person can catch the fall quickly and have the strength to lessen the impact of the fall or stumble. “Longitudinal data have shown that it is the combined effects of vision loss and poor balance that dramatically increases fall risk, and that musculoskeletal decline and loss of strength is exacerbated with concurrent vision loss.” (Keay et al., 2017)

With the constant injuring of the ankle, especially in the blind population, there is a higher chance of a weak ankle and a higher chance of reinjuring the same ankle. “Therefore, these patients enter a negative feedback loop by which each injury leaves the joint more vulnerable to subsequent injury, exposing the joint to atypical forces that contribute to degenerative changes. Because as many as 70% of patients with ankle sprains experience recurrent injury and enter this negative feedback loop, primary prevention is paramount to diminishing the global burden of this common condition.” (Kaminski et al., 2019) There are several ways for taping and bracing that can help prevent ankle sprains with a person who has not injured their ankle or has injured it multiple times. Wearing an ankle brace when you know you are going to perform high intensity activities where the ankle may have a chance to become damaged will prevent an injury from happening. Taping an ankle after an injury, even a minor one will give the ankle support during the activity they perform. Doing this with a minor injury will also prevent the ankle from getting a worse injury. This can be very costly over time especially considering the blind population that lives within the poverty line across the world. A good brace can be prescribed but when it needs to be replaced the person may not have the money to replace it or other such factors that cannot allow it to be replaced. The person who wears the brace who is blind will be able to be more aware of how the ankle moves and how it is not able to move with the brace. This will lead to a less abnormal and extreme range of motion to cause more injuries. For an acute ankle sprain the standard method used to treat would be to Rest, Ice, Compress, and Elevate. This method only works for a brief period of time. (June 2019 - Volume 18 - Issue 6: Current Sports Medicine Reports, n.d.) This may not work at all for a blind person where their main form of getting around is walking. “Up to 40% of patients who sustain an ankle sprain go on to develop persistent symptoms. Chronic ankle instability is characterized by persistent pain, swelling, feeling of “giving way,” and recurrent ankle sprains that continue at least 12 months after initial injury. (June 2019 - Volume 18 - Issue 6: Current Sports Medicine Reports, n.d.) Below are different methods to strengthen the ankle joint and allow the blind person to be able to have better reflexes to catch any fall or misbalance. As a blind person is sedentary or walks around their heart rate is higher than that of a sighted individual which can also cause incorrect reactions to prevent an injury. This causes a blind person to exert higher energy because they are doing more work to control their balance, and this can be altered with better strength, balance, and flexibility exercises to make this movement less stressful on the body. The Range of motion exercises are also especially useful to keep the ankle muscles from locking up and being stuck in positions that are not normal and effect the natural way of walking. The blind person that may have locked up muscles may have lack of movement in their ankle joint which can cause lack of reaction when tripping or falling and this can also lead to more serious injuries. The proprioception and neuromuscular control that a blind person may not have been a large factor for serious injuries in the lower extremities and other parts of the body since they compensate for the lack of movement in the ankle and the lower leg.

Orientation and Mobility Instructors will be given this program to start off all their clients with the basics and advance them as they become more confident and stable. After the client has progressed with getting taught under the Orientation and Mobility instructor, they can bring the exercises to their daily activities and perform them on their own. Goals can be set by having longer and longer time periods to hold the balance exercises. For example, starting off at ten seconds and building up to two minutes to hold a balance exercise. The range of motion exercises below can start off with being completed three times a day; in the morning, in the afternoon, and in the evening. The stretching, balance and strengthening exercises can be completed three times a week for thirty to sixty minutes a day. When adding the balance, stretches, and strengthening exercises into a whole exercise program they will start off with picking out only four to five exercises and putting those into a less than thirty-minute workout. This would be a short workout to start because the blind person may not have the stamina or advanced skills to perform them for a longer set of time. Once the blind person feels like they can lengthen the time they do exercising they can increase the program that is created to thirty minutes or more. They will pick more than five exercises to complete in all the categories. These are the most effective exercises to warm up the ankle joint and leg before a longer walk so that the muscles are more prepared to adjust smoother in movement. When doing the stepping movements, a blind person will start off with two steps per foot for a total of four steps. The blind person may find this difficult if they already have an abnormal stepping pattern. As the person has less difficulty with taking those few steps the blind person can increase to ten steps per foot for a total of twenty steps with each version of stepping. When measuring these goals, the blind person can increase their flexibility from being able to move the ankle in a small Rom to a fuller and wider range. When measuring the other types of exercises the blind person will be able to hold balance exercises for longer durations, perform more sets of exercises as strength increases, and hold the stretches for longer durations.

## Exercises

### All these exercises are related to flexibility and can be increased by using resistance bands or holding the movement starting off at 10 seconds to 2 minutes.

* Plantar flexion that can be completed to the best Range of Motion.

\*This is when you push your toes away from your body as much as you can.

* Dorsi flexion that can be completed to the best ROM.

\*This is when you pull your toes into your anterior leg, moving the top of your foot towards your shin as much as you can.

* Inversion flexion that can be best completed with Rom.

\*This is when you turn the bottom of your foot inward as if you are curling just your foot in towards your body.

* Eversion flexion that can be best completed with Rom.

\*This is when you curl the bottom of your foot outward. This will be a harder movement with the anatomy of the foot, but this is an important movement.

* Ankle circles to the right that can best be completed with Rom.

\*This is when you circle your ankle while starting towards the right and circling it to the left and back to the right.

* Ankle circles to the left that can be best completed with Rom.

\*This is when you will circle your ankle to the left and then to the right and back to the left to complete an entire circle.

### All these stretches can be held for 10 seconds or up to 2 minutes as flexibility increases.

* Sitting hamstring stretch

\*This is an exercise where you will be sitting on a floor. You will sit on the ground with both of your legs straight in front of you and reach to your neutral toes. This can be alternated with spreading your legs apart and reaching your opposite arm to the opposite foot.

* Sitting adductor stretch

\*This is stretch where you will pull your feet inward towards your body and push slightly

down on your knees. You do not have to push hard or fast.

* Outer Quad stretch

\*This is a stretch where you will put one foot over the other leg where your foot is on the outside of your opposite knee. With the bent leg push the outside of the leg outward.

* Standing Quad Stretch

\*This is a stretch where you will use a wall or chair for balance. You will gently reach down and grab the front of your foot and pull your lower leg to your butt. This will be felt on the front side of your thigh.

* Standing Calve Stretch

\*This is a stretch where you will need a wall to put your foot against. Depending on your flexibility put your toes or more of the bottom of your foot against the wall and drive your heal down to the ground.

### All these Exercises are related to balance. They can be increased from 10 seconds to 2 minutes as your balance increases. With the walking exercises you can increase your distance up to twenty-five meters after starting off with several steps.

* Walking on your toes

\*This will be walking several steps on your toes as high as you can get.

* Walking on your heels

\*This will be an exercise where you will take several steps while walking on your heels and your toes pointed to the sky.

* Walking Everted

\*This is an exercise where you will walk on the outside of your foot for several steps.

* Walking Inverted

\*This is an exercise where you will walk on the inside of your foot for several steps.

* Standing on one leg.

\*This will need a wall or chair nearby.

* Standing with one hand against a wall or less with one finger

\*This will be done when you have advanced with balance so you will decrease the full hand on the wall down to one finger on the wall while your balance on one leg. Make sure that not all your weight is on your hand.

* Standing with feet together

\*This will need a chair or wall nearby.

* Standing with one heel touching the toes of your other foot.

\*This is when one foot is in front of the other and you will need a wall or chair nearby.

* Using Physio ball or Yoga ball while sitting on it

\*You can just start off with sitting on this ball for short periods of time and increase sitting on the ball as you gain balance.

* Sitting on a Physio ball or yoga ball with one leg elevated

\*This will be started off by sitting down on the ball with one leg elevated to a parallel line to the ground. This can be increased by just lifting the leg up and putting it down right away. As you get better you can hold your leg up.

* Stepping on a Bosu ball

\*This would be standing and stepping one foot on a Bosu ball and then stepping the other foot on the ball. You would not hold this but step back to your flat surface.

* Standing on a Bosu Ball

\*This would be when you put both feet on the Bosu ball and hold the position and increase your holding of the position when your balance increases. Then you will go back to your level ground.

### All the below exercises can be increased with difficulty by adding a resistance band around the feet or ankles or ankle weights starting off at a lower weight. All of these can also be increased by holding the position for 10 seconds and increasing to 2 minutes overtime.

* High Knees

\*This is when you raise your knees in front of you as high as you can. Hip flexibility may prevent you from going extremely high and that is simply fine.

* Butt Kicks

\*This is when you kick back with your legs to hit your butt. You may not be able to reach your butt right away and this is fine.

* Calve Raises

\*This is an exercise where you may need a chair or wall. You will raise yourself on your toes and gently lower yourself back down.

* Hip Abduction

\*This is when you will need a wall or a chair to help with balance. You will stand and with keeping your leg straight you will have your leg go to the side as high as you can lift it and put it back down.

* Hip Flexion

\*This is another move you will need a wall or a chair for balance. You will stand in a straight position and lift your leg as high as you can forward.

* Hip Extension

\*This is a move where you will also need a chair or wall. You will stand in a straight position and lift your leg backwards as far as you can. Your leg will not go extremely far because of the anatomy of the hips.

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