

ORGANIZATION NEWS

Information/Education Page

Exoskeleton-Assisted Walking for People With Spinal Cord Injury



What is exoskeleton-assisted walking?

Exoskeleton-assisted walking (EAW) refers to a robotic suit worn on the body enabling a person with paralysis to stand and walk. The device is controlled by the user's weight shifting.

What are the benefits of EAW?

The health benefits of standing and walking after spinal cord injury (SCI) include improved bone density, cardiorespiratory function, gastrointestinal function, and sitting balance, and decreased pain and spasticity.

People with SCI who participate in research-based EAW training programs report improvements in spasticity, skin health, pain, diabetes, bladder and bowel function, and fat loss, and some people state small changes in feeling and movement in their trunk and legs.



Fig 1

Precautions and contraindications

You should check with your doctor or physical therapist to determine whether you are a candidate for an EAW program.

Precautions or what may stop you from EAW

- Uncontrolled spasticity or clonus
- Current infection, pressure sores
- Cardiopulmonary concerns (unstable blood pressure, autonomic dysreflexia)
- Problems with thinking and/or communication (difficulty learning new skills, impulsivity, as well as problem-solving and memory impairments)

Contraindications or do not try EAW if you experience

- Joint contractures of any arm or leg limiting a normal walking pattern while walking with a rolling walker or crutches
- Wounds or other skin problems that the device framework might irritate and cannot be adequately healed
- Any medical issue preventing or limiting full weight bearing and ambulation (eg, orthopedic injuries, pain)
- Pregnancy

Is this right for me?

Factors to consider when deciding whether an EAW training program fits your needs

- *Lower extremity paralysis or paresis:* EAW is most useful for individuals who rely primarily on a wheelchair for their mobility because of partial or complete paralysis of both legs.
- *Height:* Your height is between 5'2" and 6'3" (160–190cm) so you can physically fit into the device.
- *Weight:* The top weight limit for most devices is 220lb (100kg) for you to be positioned and trained in the device.
- *Upper body strength and trunk control:* Most robotic exoskeletons on the market today require fair plus to good upper body strength and fair plus to good seated trunk control. Are you able to complete a full sitting pushup? Are you able to complete a same height transfer without using a transfer board?

These types of robotic exoskeletons work best for people with SCIs at the first thoracic vertebra (T1) and below. EAW relies greatly on trunk balance, weight shifting, and coordination of forearm crutches to correctly stand and walk. There are, however, exoskeletons not requiring good upper body strength, and those can be used by individuals with cervical-level injuries (C7 and above).

- *Independent manual wheelchair skills:* The ability to propel a manual wheelchair and transfer to and from your wheelchair and bed or car independently without dependence on sliding boards or lifts is a predictor of success with EAW. The upper body strength, trunk control, and body awareness required to complete these skills are similar to those needed to transfer into and out of the exoskeleton suit, go from sit to and from stand, and walk in the device using forearm crutches.
- *Ability to stand erect in a standing frame for 30 minutes:* This skill is important because of a medical condition known as orthostatic hypotension—a sudden drop in blood pressure caused by moving from a sitting to standing position causing a person to feel dizzy and nauseated, or fainting may occur. Orthostatic hypotension is fairly common among individuals with SCI because of decreased nervous system control of blood pressure and decreased muscle tone. It can be prevented

during EAW by acclimating your body to standing through a consistent daily standing frame routine of up to 30 minutes. The ability to perform arm movements while in the standing frame without any drop in blood pressure is also an important prerequisite for EAW training with forearm crutches.

- *Sufficient bone density:* If you are considering participating in EAW training, a bone scan is recommended to assess your bone density and risk for fractures. Your doctor will interpret the bone scan results to make sure your bones are strong enough to withstand weight-bearing activities.
- *Good joint range of motion:* In order to stand and walk, you must be able to get both feet flat on the ground with your knees and hips straight. It is also important that you have free arm movement to use forearm crutches throughout sit to stand and walking activities.
- *Minimal lower extremity spasticity:* Leg spasms commonly occur among individuals with SCI and can be improved with a consistent stretching program and/or medications, if necessary. As long as your spasticity is well managed and does not restrict joint range of motion or function, it should not prevent you from participating in EAW.
- *Strong motivation and desire to ambulate:* This is perhaps the most important factor when determining whether EAW is right for you; because of the rigorous nature of the training, it is hard work! Learning to walk assisted by a robotic exoskeleton is exciting and potentially beneficial for health and well-being, but it does require tremendous dedication and commitment. Proficient exoskeleton use requires 20 or more training sessions, even for fast learners, over a period of months with a skilled therapist.



Fig 2



Fig 3

Where can I find a facility that provides an EAW program?

The best place to find a facility offering an EAW training program is the device manufacturers' websites. The current Food and Drug Administration (FDA)-approved robotic exoskeletons are Ekso, ReWalk, and Indego. Centers located throughout the United States offer EAW training programs either as part of their physical therapy program or through their research department.

EAW screening

If you are interested in EAW training, you will need to schedule a screening appointment with a physical therapist at one of the above training centers. The therapist will review your medical history, perform a range of motion and strength examination, review your skin integrity and muscle tone, and assess your functional mobility skills. Most insurances will cover the costs of training under your therapy benefit, though they usually require a prescription for EAW training from your physician. Several of these devices (ReWalk, Indego, Phoenix) received FDA clearance for personal use and are now available for purchase in the U.S, with pricing typically in the range of \$40,000 to \$70,000 depending on the unit. Insurance coverage of these costs varies by individual company.

Helpful websites: providing more information about EAW

EKSO: www.eksobionics.com Indego: www.indego.com ReWalk: www.rewalk.com Rex: www.rexbionics.com (not available in the U.S) Phoenix: www.suitx.com/phoenix (research only)

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