

# A RAPID REVIEW ON ROBOTIC (EXOSKELETON) TO EVALUATE BALANCED, STANDING AND WALKING

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## Abstract

Balance evaluation during standing and walking is efficient chiefly in people with neural compensations. Rehabilitation robots, on the other hand, might make evaluation processes easier and increase their clinical usefulness. We analysed the possible use of robotic instruments for such assessments based on this overview. The uniqueness and presumed key benefits of utilising robots for assessment include their capacity to assess severely afflicted patients by offering assistance-when-needed, as well as their ability to give constant perturbations while standing and walking while recording the patient's reactions. We classify robotic devices based on three factors that are significant to their potential application in balance assessment: 1) the device's interaction with the human body; 2) on what surface the individual stands or walks when using the gadget, and 3) To what extent the wearable devices are. Also, robotic support was easy to use with no undesirable effects of skin abrasions or soreness.

**Keywords:** Robotics, Exoskeleton, Wearable devices, Standing & Walking, Balance.

## INTRODUCTION

New rehabilitation procedures benefit greatly from the application of contemporary scientific information on neurorehabilitation and neural plasticity, such as task-specificity, context-particularly, or high-intensity and repeated repetition. Over the last ten years, a variety of locomotor assistance robotic devices have been created. The majority of them are intended to be used as a medical or nursing equipment for walking assistance, even so they may also be utilised as a training device(1).

Robotic exoskeletons are wearable equipment with motorized components that enhance locomotion as well as dexterity(2). Over time, robotic exoskeletons have grown increase readily accessible, and they now have the prospective to be effectively used. It is critical, however, that people have realistic assumption. Each robotic exoskeleton has different characteristics and capabilities, and how exoskeletons are used varies widely amongst people. Using robotic exoskeletons, people with varied degrees of disability may be able to walk with safety and effectively for personal physical activity(3).

From standing erect to walking on not even terrain, maintaining balance is an important part of many everyday actions. We stated that balance as the ability to maintain a constant and sufficient bodily position in order to prevent falling. Impaired balance is frequent in individuals with a variety of health disorders, particularly those who have suffered neurological impairment from CVAs (strokes), traumatic brain injuries (TBIs), or spinal cord injuries (SCI)(4).

The hybrid assistive limb (HAL) exoskeleton was created to help patients with motor function by tailoring it to their voluntary drive. For patients who are bedridden and wheelchair restricted, decubitus, loss of bone density, lower-limb articular contracture, and deep-vein thrombosis are all hazards. Gait assistance utilising an exoskeleton robot may be a viable approach to cure the aforementioned difficulties since a patient putting an exoskeleton robot to move their legs actively and the ground response force stimulates the sensory and musculoskeletal systems. Wearable systems with powered joints that assist with

movement and mobility are known as robotic exoskeletons. These devices can be divided into two categories based on their intended use: rehabilitation and gait aid(5).

Exoskeletons for the legs have been increasingly popular in recent years, both in research and on the market. These robots are designed to assist their human users with everyday leg movements like standing and walking.

Leg exoskeletons are expected to be used in a variety of applications, including:

- Worker assistance: assisting a healthy user with a specific job, such as carrying a load.
- Rehab training: individuals with neurological impairment are trained in brief sessions.
- Assistive device: to help healthy, weak, or disabled individuals extend their walking capabilities in a day-to-day setting(6).

Wearable technologies for balance testing and control of postural instability have been available in the last 15 years, notably for patients with neurological problems(7).

#### POSTURAL BALANCE CONTROL IN EXOSKELETONS –

Humans seek to move the body's center of mass (COM) in the desired direction or retain it in a safe and secure position while doing tasks such as walking, standing, or standing up. This necessitates a command of the forces at work. On the Committee of Management, These forces can be produced by the leg joint, torques, either by moving the upper body and limbs or by moving the lower body and limb repositioning the feet in relation to the center of mass such tactics for achieving equilibrium can be aided by exoskeleton. It's especially well-suited to being supported by a leg. The adaption of joint stiffnesses (or exoskeleton) Leg stiffness (virtual) and proper foot placements. In the case of a human wearing an exoskeleton, both the human and the exoskeleton are working toward the same goal (both with their own set of strengths and limitations): doing tasks quickly and securely (execution time, energy), a functioning task (without falling). However, owing to several factors, it's possible that both entities aren't on the same page. executing well-coordinated and beneficial acts, and creating general system disturbances that might be dangerous to the environment user(8).

Furthermore, proper assistive methods form the human-robot motion, which benefits the motion's assistive isotropy and increases the force's assistive efficiency in balanced standing and walking to improve human walking efficiency(9).

Human data and output functions that appear to be essential to human walking are utilised, we may create controllers that yield in stable robotic walking. Outputs—or kinematic functions—are derived from data on human walking, producing a low-dimensional description of human movement. To link robot outputs to human outputs, human-inspired control is utilised and these comparable outputs are classed as robot outputs. The main findings of this paper are that this controller's settings may be chosen using a human-inspired optimization problem that gives the greatest match for human data while ensuring steady robotic walking in both under and full actuation cases, and the initial condition may be calculated in closed form(10). The findings of this investigation will help us to determine if the whole method, including determining before a final randomised controlled trial, eligibility of the patient, baseline evaluations, randomization, consistent treatment, and post-assessments can be carried out in explicit way (RCT)(11-25).

#### POTENTIAL BENEFITS OF EXOSKELETON–

Overground robotic exoskeletons may give therapeutic advantages while offering rigorous overground stepping practise, and may require fewer therapists to aid with stepping and stability during training in persons with extremely limited stepping function than other techniques. Exoskeleton usage has also been linked to better posture, less spasticity, and fewer issues affecting the cardiovascular, gastrointestinal, and renal systems, according to the research. Exoskeletons may thus offer an alternate way for achieving the same advantages as traditional mobility training methods(26-35).

#### EXOSKELETON USED IN REHABILITATION -

1] IN STROKE -

Powered robotic exoskeletons are a newer technology that allows people to walk without the constraints of earlier mechanical devices due to lower extremity weakness. These wearable robots may be wrapped around the torso and legs to control joint mobility and automate overground walking without the need for a treadmill or an overhead harness system. Preliminary research has shown that powered robotic exoskeletons are safe for people who have had a stroke, but there have been few clinical trials to determine their efficacy, and even fewer studies have compared exoskeletal gait training to regular physical therapy during the early stages of stroke recovery(13).

## 2] IN SPINAL CORD INJURY (SCI)-

One of the most noticeable limitations that people endure following a spinal cord injury is the inability to walk (SCI)(14). Although there are currently a multitude of technologies available, research into the use of overground robotic exoskeletons in the rehabilitation of patients with SCI has mostly concentrated on three systems: Ekso, ReWalk, and Indego, all of them are aimed at assisting gait and promoting ambulation(36-43).

## Summary and future perspective

In order to achieve articular decoupling and comprehensive coverage of the whole leg motion, Exoskeleton robotized implants and devices for rehabilitation are frequently designed with mechanical joints that match and align with human limb joints. This study looked at the safety, practicality, and mobility of our newly designed powered lower limb exoskeleton robot. After motorized exoskeleton gait therapy, patients were able to utilize the motorized lower limb exoskeleton robot autonomously and without help. Also, robotic support was easy to use with no undesirable effects of discomfort, skin abrasions or soreness. This robotic technology and accompanying concepts have far-reaching implications for measuring and recovering motor capabilities in humans. Over-ground walking is improved with hybrid assistance limb exoskeleton training, implying that it has a positive impact on balanced standing and mobility. However, bigger clinical studies are necessary for assessment. These results suggest that rehabilitation, which includes intense activity-based therapy, can help people to improve their functional abilities.

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