

Article

Design of a Biomechatronic Device for Upright Mobility in People with SCI Using an Exoskeleton Like a Stabilization System

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Abstract: This paper presents a novel biomechatronic device that resolves the necessities of mobility for people with spinal cord trauma (SCI) and disability. The proposed device features a safe and reliable mobility mechanism that withstands daily use without premature mechanical wear, facilitating the activities of daily living (ADL) for people affected by SCI, integrating them to a social and workforce environment that allows them, on one hand, to move in a standing upright position in complex situations of the urban architecture, and on the other hand, provides them a mechatronic system to assist them to stand up and sit down.

Keywords: biomechatronics; SCI; upright mobility



Citation: Hernandez-Ramos, M.; Flores-Cuautle, J.J.A.; Filippeschi, A.; Rodriguez-Jarquín, J.; Landeta-Escamilla, O.; Jacinto-Villegas J.M.; Sandoval-Gonzalez, O. Design of a Biomechatronic Device for Upright Mobility in People with SCI Using an Exoskeleton Like a Stabilization System. *Appl. Sci.* **2022**, *12*, 8098. <https://doi.org/10.3390/app12168098>

Academic Editor: Ana Lopes

Received: 5 June 2022

Accepted: 2 August 2022

Published: 12 August 2022

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1. Introduction

The physiological functions and internal organs of a human being are adapted to the standing upright position and biped locomotion. Accidents and diseases such as cerebral palsy, embolism, spinal cord injury (SCI), muscular dystrophy, and post-polio syndrome generate adverse conditions such as muscular stiffness, tendon deformations, bone density loss, urinary infections, and intestinal constipation [1].

SCIs present different grades of affectations in the body (partial and total paralysis in human limbs) and are classified with respect to the level of location according to the American Spinal Injury Association (ASIA) using the International Standards for Neurological and Functional Classification of Spinal Cord Injury [2].

The mobility options for people affected by SCI are limited [1] and in the case of motor disability the option of mobility that is widely used is the wheelchair of manual impulse [3]. However, the wheelchair produces secondary problems generated by long periods of time when the users remain seated, producing physical and social problems called secondaries such as blisters, osteoporosis, gastric problems, urinary tract infections, tendon deformation, muscle atrophy, mental stress and low self-esteem. The low self-esteem is presented by the condition of looking from a low position, but can be decreased if the patient stands up, remains standing and moves in a standing upright position. Exoskeletons are an option for substituting wheelchairs, and those high-technology devices allow them to accomplish Activities of Daily Living (ADL) such as those listed in Table 1. It is worth mentioning that both devices have their own problems with working effectively in an urban environment designed for healthy people. The trend in exoskeletons is to add everyday high technology sensors, actuators, and electronic control devices [4] that, in short, are genuine contributions to science and technological development but, due to their level of