A Protocol to Test Passive Mobile Back Exoskeletons for Industrial Manual Lifting Tasks

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Abstract. A comprehensive protocol is presented, designed for the evaluation of **passive back exoskeletons** intended for load lifting in industrial settings. This protocol consists of various biomechanical tests grouped into **four phases** to be completed by users, both with and without the exoskeleton. The **first phase (Anthropometric Assessment)** collects data used to calculate derived indices (BMI, BSI, BPI). The **second phase (Comprehensive Static Assessment)** consists of four tests: CTSIB and LOS (Neurocom Balance Scale), Automated Posturography (EPPA!), and Test Static Posture (BTS FreeEMG1000). The third phase (Kinematic Evaluation) analyzes gait kinematics (Gait Quality Index and EMG-Walk Protocol) and the load lifting gesture in three modalities (self-regulated, trunk flexion, and squatting). Each study is complemented by sagittal plane video analysis (left side) to quantify relevant biomechanical variables (Kinovea®).The fourth phase (Kinetic Evaluation of Load Lifting with EMG) assesses the surface electromyographic response of the lumbar erector spinae during load lifting using the Flex and Relax test (BTS FreeEMG1000 and G-Walk-BTS).The protocol was implemented in a pilot sample consisting of two healthy volunteers (male and female). The choice of loads was based on Resolution 886/15, currently in force in our country. It is considered that the protocol enables an exhaustive qualitative and quantitative comparison of the motor gesture. The aim is to define reliable performance indicators based on a Conditional Logistic Regression model (matched samples) using R software.

Keywords: Occupational Biomechanics · Industrial Exoskeletons · Occupational Health

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