EVALUATION OF A NOVEL INTELLIGENT ORTHOTIC KNEE JOINT

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Introduction: A novel microprocessor controlled orthotic knee joint was developed by combining the Ottawalk-Speed mechanical design, Endolite Elan prosthetic foot control system and valve, and a new interface manifold. The resulting variable stance control KAFO (VSCKAFO) is low profile and enables safe mobility across multiple surfaces and activities by dynamically adjusting knee flexion resistance during gait, based on real-time multiple-sensor analysis at the thigh and knee. This new VSCKAFO addresses size and modularity limitations of other microprocessor controlled KAFO's (i.e., fits beneath clothing, all sensors within the device), enabling a modular design and patient-specific decisions on ankle joints and foot section.
Purpose: Evaluate the VSCKAFO biomechanical performance in terms of appropriate mode switching and variable knee flexion resistance.
Method: Five able-bodied participants were recruited for this pilot assessment (i.e., test able-bodied participants before testing with KAFO users). Participants were fitted with the VSCKAFO and VSCKAFO settings were adjusted to the participant during an accommodation period. A lower body, 6 degree of freedom marker set was affixed to each participant before walking along an 8m walkway. Five strides of 3D motion analysis data (10 camera Vicon System, 2 force plates) were collected. Following level walking, kinematic data were collected from each participant during stair descent and sitting.
Results: Level walking stride parameters, kinematics, and kinetics were similar between free movement and dynamic knee control trials. For stair descent and sitting, the knee successfully controlled knee flexion to enable safe decent.
Discussion and Conclusion: The novel VSCKAFO performed as designed by determining gait phases using the integrated sensors, rapidly adjusting knee flexion resistance during movement, and resisting knee flexion during weight-bearing while allowing free knee motion during swing. The successful biomechanical analysis supports further testing of this VSCKAFO with people with knee extensor weakness.