Engineering a Clinical Force Measuring Walker for Patients with Restricted Upper Extremity Weight Bearing

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Patients often need use of their arms to assist with functional activities, but after bone disruption, pushing is often limited to <10 lb (4.5 kg). Currently, no method exists to measure upper extremity weight bearing (UEWB) objectively in clinical settings. The engineering goal of my project was to design, construct, and test a walker for patients who need to limit UEWB to prevent excessive bone stress during post-fracture (iatrogenic or traumatic) ossification. First, I conducted a secondary data analysis comparing UEWB force during functional mobility in younger vs. older subjects. Results suggested that patients, particularly older ones, may not be accurately estimating UEWB <10 lb, and that feedback training is effective for improving accuracy. This established proof-of-concept, the need for a Clinical Force Measuring (CFM) walker, and its efficacy with feedback training. Next, I completed a qualitative study to obtain critiques of a CFM walker prototype from rehabilitation professionals. I coded key statements and phrases that allowed “themes” to emerge from transcribed interviews, which guided device revisions. Lastly, I fabricated and tested a second CFM Walker prototype that was lightweight, streamlined, and cost-effective; it had a simple visual display and auditory cue with upper limit alarms. Key features included attachments for medical equipment and thin film force-sensing resistors integrated into the walker handles that progressively activated 3 LEDs and a buzzer when UEWB force exceeded programmed thresholds. In conclusion, the innovative CFM Walker will help patients with restricted UEWB, especially elderly adults, recover safer and faster in the future.

Awards Won:

International Council on Systems Engineering - INCOSE: Certificate of Honorable Mention