Tibion Bionic Leg: Research Highlights

Untethered, task-oriented training improves gait, balance, and functional recovery in ambulatory chronic stroke survivors

The Tibion Bionic Leg is the first battery-powered, wearable, lower-extremity robotic trainer that provides patient-initiated, powered assistance during untethered functional-mobility training in the clinic.\(^1\)

With the help of a skilled clinician, the device settings are programmed to augment the patient’s level of participation, and the level of robotic assistance with concentric and eccentric knee extension. Using the Bionic Leg under therapist supervision, patients are able to practice overground gait, transfers, balance, and reciprocal stair negotiation unlike ever before.

**Study Summary: A Wearable Robotic Knee Orthosis for Gait Training: A Case-Series of Hemiparetic Stroke Survivors.**


A team at the Columbia University Medical Center Department of Rehabilitation and Regenerative Medicine evaluated the Tibion Bionic Leg for functional mobility training in chronic stroke survivors. Three subjects, ranging from 26 to 40 months post-stroke participated in a six-week physical therapy program using the Bionic Leg. Therapy sessions were 3 times per week and approximately 90 minutes in length. Balance, gait, ambulation speed, endurance and other additional functional measures were assessed at baseline, immediately after the treatment, and at one- and three-months post-intervention.\(^2\)

Immediately following the treatment program, all subjects demonstrated improved balance, ambulation speed, endurance, and functional performance. Gains from therapy were maintained after one and three months, despite the absence of any specific training in the follow-up period.

**Stroke survivors do not consistently maintain gait speed and endurance gains after rehabilitation – especially after three months – however gains in this case series were maintained for all subjects.**\(^2\)

At 3 months-post intervention, subjects demonstrated the following overall gains:

- +25.0% for Ambulation Speed
- +16.5% for Berg Balance Scale
- +16.0% for Six-Minute Walk Test
- +19.5% for Emory Functional Ambulation Profile

This study also highlights the benefits of use of the Bionic Leg for over-ground balance training with higher-functioning, chronic subjects:

“The [Bionic Leg] provides clinicians with a new option that may be beneficial in untethered over-ground functional training outcomes for some stroke survivors.” — Wong et al, Prosthetics and Orthotics International 2012
With the Tibion Bionic Leg, therapists are able focus on strategies designed to enhance active motor learning and functional recovery of mobility.

- **Timing:**
  Beginning bedside during the first days post-stroke to promote weight acceptance on the involved limb with transfers, and standing with focus on restorative patterns of movement. Progress the patient through the continuum of care to therapy in the home, negotiating their own stairs.

- **Motivation:**
  The Bionic Leg requires a therapist-adjustable level of patient effort before robotic assistance is provided. As the patient progresses through therapy, assistance can be dialed back to optimize paretic limb work. This encourages active participation from the patient towards restorative training – not more compensatory mechanisms.

- **Feedback:**
  Real-time feedback from the mechanical assistance and auditory cueing empowers the patient and the therapist to recognize and correct movement patterns, practicing the task at hand correctly and safely.

- **Intensity and Repetition:**
  With use of the adjustable settings to match or challenge strength in the impaired limb, the patient can safely be encouraged to work more intensely and independently than before. By augmenting patient ability, reducing fear of falling, and therapist-injury risk, the Bionic Leg can significantly increase the number of repetitions in a typical therapy session.

- **Specificity and Salience:**
  With the device, patients can walk outside the clinic over varied terrain, practice getting in and out of a real car, and negotiate curbs and steps as they will in the community. Reprogram patients’ expectations and movement pathways simultaneously.

- **Transfer of Knowledge:**
  By implementing “Parts to a Whole” treatments with the Bionic Leg, clinicians can break down tasks to core elements and enhance learning. Utilizing the “carry-over” of training effects following Bionic Leg training, clinicians are able to reinforce learning by assigning exercises and task-specific activities for patients to work on outside of therapy.

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References: