

ElanIC

Elan was the first of its kind, taking the microprocessor-control technology more commonly seen in prosthetic knees, and applying it to the Echelon, an articulating prosthetic foot-ankle device with hydraulic damping. As such, it retains the benefits achieved by Echelon, in fact enhancing performance with the ability to control how much resistance is applied and at what time.

The addition of this control is especially beneficial during slope ambulation where it reduces energy expenditure of the user and improves stability and safety, particularly during descent. The control also enhances stability whilst standing, where resistances can be increased, thus decreasing the amount of energy required by the user to balance.

The inductive charging feature increases the ease with which the Elan can be charged and also introduces a waterproof feature to the device.

Improvements in Clinical Outcomes using Elan compared to ESR feet

Improvement in **SAFETY**

- Reduced risk of tripping and falls
 - Increased minimum toe clearance during swing phase^{1,2}
- Improved knee stability on the prosthetic side during slope descent
 - Increased mid-stance external prosthetic knee extensor moment³
- Improving standing balance on a slope
 - 24-25% reduction in mean inter-limb centre-of-pressure root mean square (COP RMS)⁴

Improvement in **ENERGY CONSUMPTION**

- Reduced energy expenditure during walking
 - Mean 11.8% reduction in energy use on level ground, across all walking speeds⁵
 - Mean 20.2% reduction in energy use on slopes, across all gradients⁵
 - Mean 8.3% faster walking speed for the same amount of effort⁵

Improvement in **MOBILITY**

- Improved gait performance
 - Faster self-selected walking speed^{2,6-9}
- Improved ground compliance when walking on slopes
 - Increased plantarflexion peak during level walking, fast level walking and cambered walking¹⁰
 - Increased dorsiflexion peak during level walking, fast level walking and cambered walking¹⁰
- Less of a prosthetic “dead spot” during gait
 - Reduced aggregate negative COP displacement⁷
 - Centre-of-pressure passes anterior to the shank statistically significantly earlier in stance⁷

- Increased minimum instantaneous COM velocity during prosthetic-limb single support phase⁷
- Reduced peak negative COP velocity⁹
- Reduced COP posterior travel distance⁹
- Improved ground compliance when walking on slopes
 - Increased plantarflexion range during slope descent³
 - Increased dorsiflexion range during slope ascent³
- Less effort on residual hip for trans-femoral amputees on varied terrains
 - Reduced the mean hip extension and flexion moments¹¹
- Effects consistent over time
 - Same gait variable changes in two gait lab sessions one year apart⁶
 - Magnitude of changes comparable between sessions⁶
- Brake mode during slope descent to control momentum build up
 - Reduced mean prosthetic shank angular velocity in single support¹²
 - Increased Unified Deformable Segment (prosthetic 'ankle') negative work¹²
- Less gait compensation movements during slope descent
 - Reduced residual knee flexion at loading response¹²

Improvement in **RESIDUAL LIMB HEALTH**

- Helps protect vulnerable residual limb tissue, reducing likelihood of damage
 - Reduced peak stresses on residual limb¹³
 - Reduced stress RMS on residual limb¹³
 - Reduced loading rates on residual limb¹³

Improvement in **LOADING SYMMETRY**

- Greater contribution of prosthetic limb to support during walking
 - Increased residual knee peak extension moment⁶
 - Decreased residual knee peak flexion moment⁶
 - Increased residual knee negative work⁸
- Reduced reliance on sound limb for support during walking
 - Reduced intact limb peak hip flexion moment⁸
 - Reduced intact limb peak dorsiflexion moment⁸
 - Reduced intact ankle negative work and total work⁸
 - Reduced intact limb total joint work⁸
- Better symmetry of loading between prosthetic and sound limbs during standing on a slope
 - Degree of asymmetry closer to zero for 5/5 amputees⁴
- Reduced residual and sound joint moments during standing of a slope
 - Significant reductions in both prosthetic and sound support moments¹⁴
- Reduced residual joint moments during standing of a slope for bilateral amputees
 - Significant reductions in prosthetic support moment¹⁴
 - Permitted 'natural' ground reaction vector sagittal plane position, relative to knee joint centres¹⁴
- Less pressure on the sole of the contralateral foot
 - Peak plantar-pressure¹⁵
- Improved gait symmetry

- Reduced stance phase timing asymmetry¹⁶

Improvement in **USER SATISFACTION**

- Patient reported outcome measures indicate improvements
 - Mean improvement across all Prosthesis Evaluation Questionnaire domains¹⁷
 - Bilateral patients showed highest mean improvement in satisfaction¹⁷
- Subjective user preference for hydraulic ankle
 - 13/13 participants preferred hydraulic ankle¹⁵

Improvements in Clinical Outcomes using Elan compared to non-microprocessor-control hydraulic ankle-feet

Improvement in **SAFETY**

- Improved knee stability on the prosthetic side during slope descent
 - Increased mid-stance external prosthetic knee extensor moment³

Improvement in **MOBILITY**

- Improved ground compliance when walking down slopes
 - Reduced time to foot flat¹²
- Brake mode during slope descent increases resistance to dorsiflexion to control momentum build up
 - Reduced dorsiflexion range during slope descent³
 - Reduced mean prosthetic shank angular velocity in single support¹²
 - Increased Unified Deformable Segment (prosthetic 'ankle') negative work¹²
 - Transition from dorsiflexion to plantarflexion moment occurs earlier in stance phase¹⁸
 - Increase in mean prosthetic 'ankle' plantarflexion moment integral¹⁸
- Assist mode during slope ascent decreases resistance to dorsiflexion to allow easier progression
 - Transition from dorsiflexion to plantarflexion moment occurs later in stance phase¹⁸
 - Decrease in mean prosthetic 'ankle' plantarflexion moment integral¹⁸
- Less gait compensation movements during slope descent
 - Reduced residual knee flexion at loading response¹²

Improvement in **LOADING SYMMETRY**

- Greater reliance on prosthetic side for bodyweight support during slope descent
 - Increased support moment integral¹⁸
- Less reliance on sound side for bodyweight support during slope descent
 - Decreased support moment integral¹⁸
- Less reliance on sound side for bodyweight support during slope ascent
 - Decreased support moment integral¹⁸
- Reduced sound joint moments during standing of a slope
 - Significant reductions in sound support moment¹⁴
- Reduced residual joint moments during standing of a slope for bilateral amputees

- Significant reductions in prosthetic support moment¹⁴
- Permitted 'natural' ground reaction vector sagittal plane position, relative to knee joint centres¹⁴

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