Bionics

Bi(o) + (electri)onics

The study of mechanical systems, especially electronic, that function like living organisms or parts of living organisms.

The transfemoral level - compensations

- Loss of PF/DF power and control
- Loss of mechanoreceptors in skin, joint & muscle
- Loss of knee extensor power and control
- Increased eccentric hip flexor work
- Increased PF work increases 30%
- Concentric hip extensor work increases 270%
- Increased time spent on sound limb in stance

Independent risk factor for falls
The Benefits of bionics

The integration of bionic technology in prosthetic solutions aims to overcome all functions lost due to amputation by:

- Increasing functionality
- Increasing safety
- Reducing future comorbidity for amputees
- Reducing effort (mental – physical)
- Stimulating voluntary control

...because the world is not flat

Level ground
- Reduced compensatory movements, particularly for swing clearance.

Inclines and stairs
- Intelligent adaptation to slopes leads to greater patient safety.

Heel height adjustment
- Powered toe clearance reduces the risk of stumbles and falls.

Walking

PROPRIO FOOT dorsiflexes during swing phase providing 15mm ground clearance
- Powered toe clearance reduces the risk of trips and falls
- Reduces the need for a shorter prosthesis
- Minimizes the need for compensatory movements
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*Stair Descent and Ascent*

PROPRIO FOOT provides powered dorsiflexion when descending stairs

Adaption in stairs improves user's safety & stability

- Can place more of the foot on the step.
- More even distribution of peak pressure in the socket.

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*Ramp Descent and Ascent*

PROPRIO FOOT adapts to inclines by providing powered toe lift in swing.

- Closer to able-bodied gait
- Improved kinematics and the kinetics of the lower limb
- More even distribution of peak pressure in the socket

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*RAMP DESCENT*

PROPRIO FOOT adapts to declines by plantarflexing

- More even distribution of peak pressure in the socket
- Earlier support during roll over
The PROPRIO FOOT adjusts to different heel heights
- Allows the user to change shoes safely
- Maintains alignment & symmetry

Functional Training – Proprio Foot
- User programming
  - On/off
  - Heel height
- Charging and battery warnings
- Troubleshooting
  - Walking speed
  - Motor sticking
- Mobility concerns:
  - Swing related gait deviations
  - Equal weight bearing
- Strategies for functional activities

...the most adaptable solution of its kind
- Proportional loading
  - Resistance varies according to weight bearing
  - Encourages weight bearing and muscle activity
- Instantaneous transitions
  - Releases to swing when unloaded for natural gait in small spaces
- Rapid knee flexion
  - Key to toe clearance and momentum
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Instantaneous transitions

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Functional Training – Rheo Knee

- Charging and battery warnings
  - Battery loss state
- Troubleshooting
  - Knee locking vs. buckling
- Mobility
  - Weight bearing and proprioception
  - Level ground walking
  - Stand to sit
  - Stairs and ramps
- Additional features – extension hold

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Locks in stance
- Stability in standing
- Stability on level and unlevel surfaces

Powered swing
- Provides toe clearance
- Maintains momentum

Lift assistance
- Sit to stand assist
- Kneeling
- Stair ascent
Functional training – Power Knee

• User programming
  On/off
  Exercise mode
  Kneeling

• Charging and battery warnings
  Battery loss state

• Mobility
  Normal human locomotion!
  Sit to stand
  Stairs and ramps

Summary

• Understanding the features of any device will help you train the user
• Open lines of communication with the prosthetist is key
• Additional information can be found on manufacturer’s websites

References