Powered Knee-Ankle Prosthesis Training for Transfemoral Osseointegration

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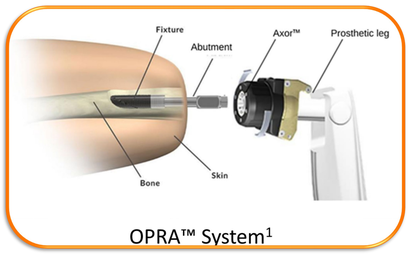
Introduction

- Powered knee-ankle prostheses may offer mobility benefits for individuals with transfemoral (TF) amputation.
- Powered prosthesis use may be enhanced by osseointegration through improved power transfer due to the bone-anchored interface.
- A structured powered prosthesis training approach developed at Shirley Ryan AbilityLab [2] provides users training progression, functional mobility instruction, user control adjustability, along with participant feedback in users with TF osseointegration.

Transfemoral Osseointegration

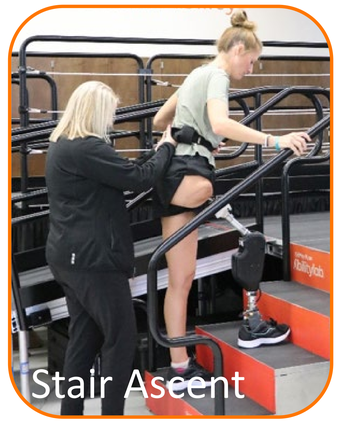


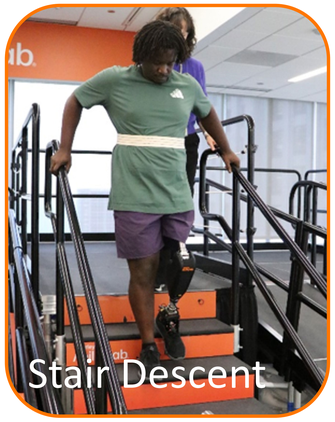
OPRA™ System[1]

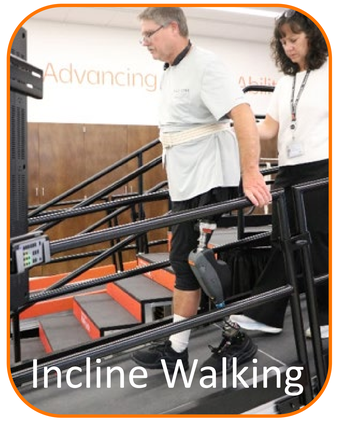
Methods

	Age (Yrs)	Gender	Etiology	Years Post-Amputation	Years Post-OI	Prescribed Knee
TF01	41	Female	Trauma	11	4.56	C-Leg
TF02	39.8	Male	Sarcoma	24.6	.90	Kneuro
TF03	32.6	Male	Sarcoma	17.2	9.07	C-Leg
TF04	51.2	Male	Trauma	2.5	2.23	C-Leg

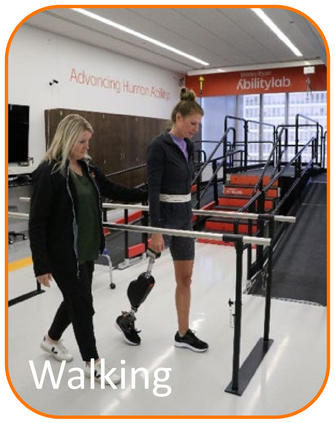
- Participants with OPRA Implant systems were fit with the Shirley Ryan AbilityLab Powered Knee and Polycentric Ankle, OPRA Axor™ II (Integrum, Sweden [1]), and an Ottobock torsion adapter.
- Training followed established procedures for TF amputees and progressed from limited knee flexion and neutral ankle settings to increased knee swing, powered plantarflexion, variable speeds, obstacle negotiation, powered sit-to-stand, incline walking, and reciprocal stair climbing.
- Comfort and vibratory feedback were monitored throughout training.


Stair Ascent


Stair Descent


Incline Walking


Sit to/from Stand


Walking


Walking

Hybrid Knee [3]
- Can operate as a passive device
- Max Torque: 120 Nm
- Knee ROM: 0°-108.5°
- Mass: 2.03kg
- Build Height: 33.2 cm

Polycentric Ankle [4]
- Max torque: 125Nm
- Ankle ROM: -20°-20°
- Mass: 1.38kg
- Build Height: 13.2 cm

Results

- Participants successfully ambulated over level ground, incline and stair climbing tasks, as well as sit-to-stand transitions, using the powered knee-ankle prosthesis. Training for each activity required less than one hour with additional walking for stability and maneuverability practice.
- **The osseointegrated interface enabled greater trunk and hip flexion without socket constraints, facilitating optimal positioning and effective use of powered knee extension during vertical transitions.**
- Parameter adjustments supported faster walking speeds, increased powered support for vertical mobility and participants reported perception of reduced prosthesis weight once powered plantarflexion was activated.

Conclusions

- **Individuals with TF osseointegration rapidly and safely acclimated to a powered knee-ankle prosthesis using a structured, progressive training approach.**
- Participants reported no discomfort and described the vibratory feedback as a beneficial source of potential osseoperception for device awareness.
- Findings demonstrate that initial powered prosthesis training is feasible, well-tolerated in this population and may confer meaningful functional benefits.
- Further work will expand participant enrollment and quantify functional outcomes to better characterize the impact of powered knee-ankle prostheses in this population.

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References: 1. Integrum, Mölndal, Sweden 2. Finucane et al., *Front Rehabil Sci*, 2022. 3. Lenzi et al., *IJRR*, 2018. 4. Cempini et al., *IROS*, 2017.

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