The Strathclyde Prosthetic Foot

A High Performance Prosthetic Foot for Low Income Countries

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Clinical Need

In the developing world there are ~1-2 amputees per 10000 people[1]. An amputation can cause significant financial strains[2,3,4-6] and social exclusion[7,8].

The anatomical foot provides **shock absorption** and **energy return**[9]; this needs to be recreated in the prosthetic foot.

The Strathclyde Foot is a dynamic, inexpensive foot for the developing world with a durable, cosmetic rubber casing.

Objectives

The main objectives were:

- **To mechanically test** the energy return, shock absorption and stiffness of the rubber-cased feet in comparison to the Core and VariFlex foot
- **To mechanically test** one rubber-cased foot against two feet that are currently available in low income countries
- **To analyse gait** of two rubber-cased feet in comparison to the VariFlex and Trés feet

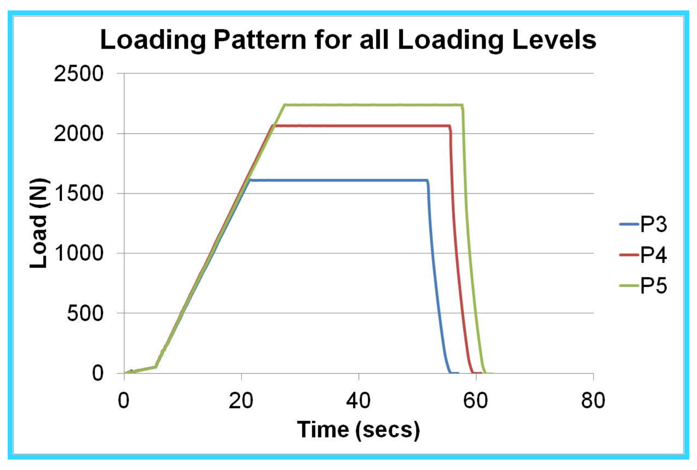
Method

Modify Mould → Modify Cores → Encase Cores in Rubber → Static Proof Testing → Market Comparison → Gait Analysis

- The core of the Strathclyde foot was **encased in rubbers** with varying shore densities (10A-40A)
- These feet were compared using **static proof testing** with an Instron E10000

Trés, VariFlex, Core, 10A, 20A, 30A, 40A, ICRC, Niagara

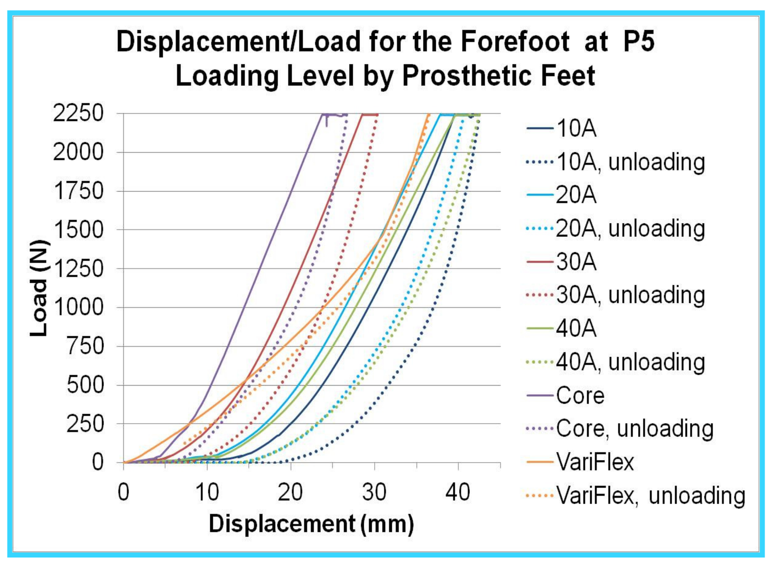
- The 40A foot was compared to **other prosthetic feet** used in low income countries. The VariFlex was used as the baseline during all static proof tests
- **Gait analysis** was carried out on the 10A and 40A feet in comparison to the Trés and VariFlex feet comparing Ground Reaction Forces (GRF) and angles

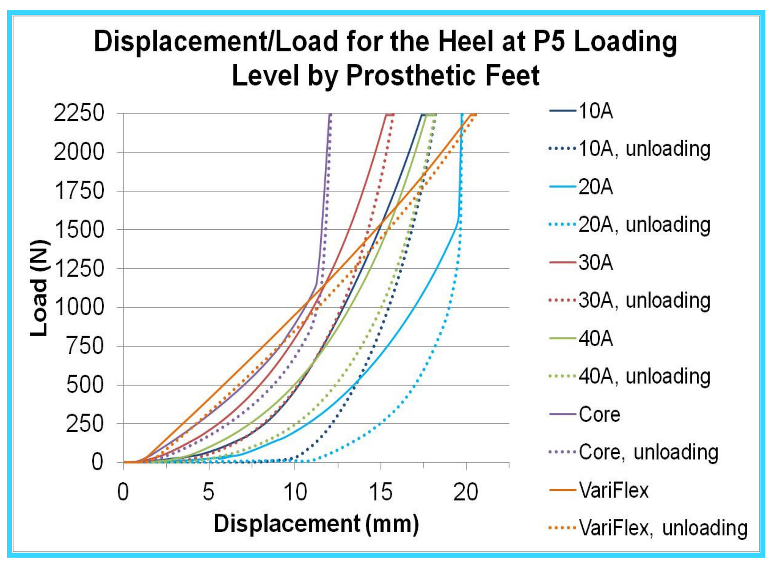


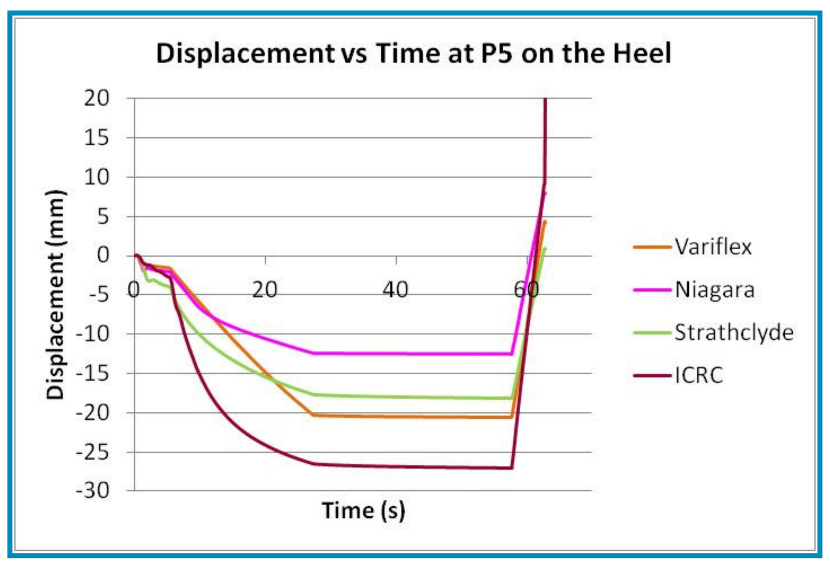
Static proof loading patterns

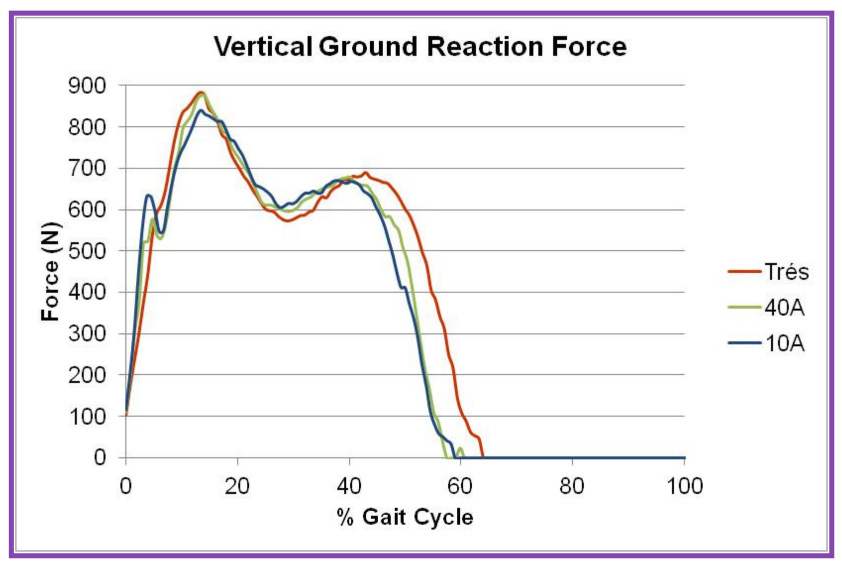
Gait Analysis using CAREN system

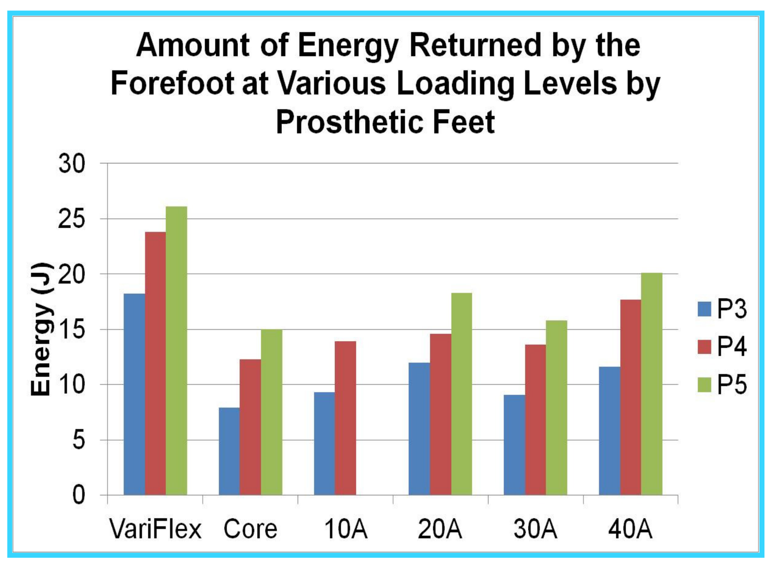
Results

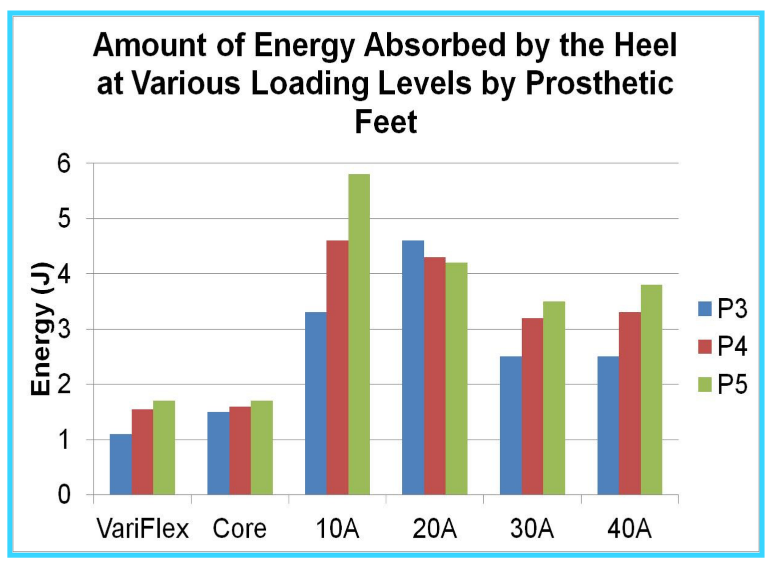


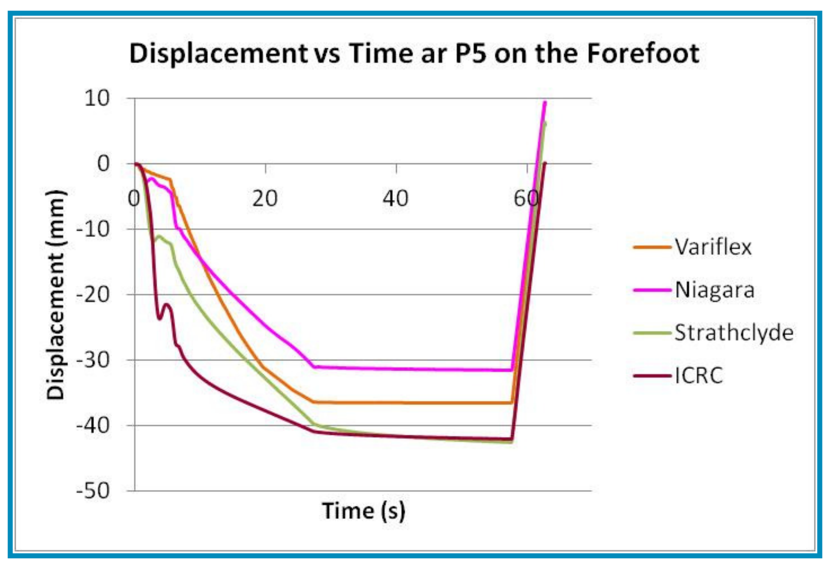


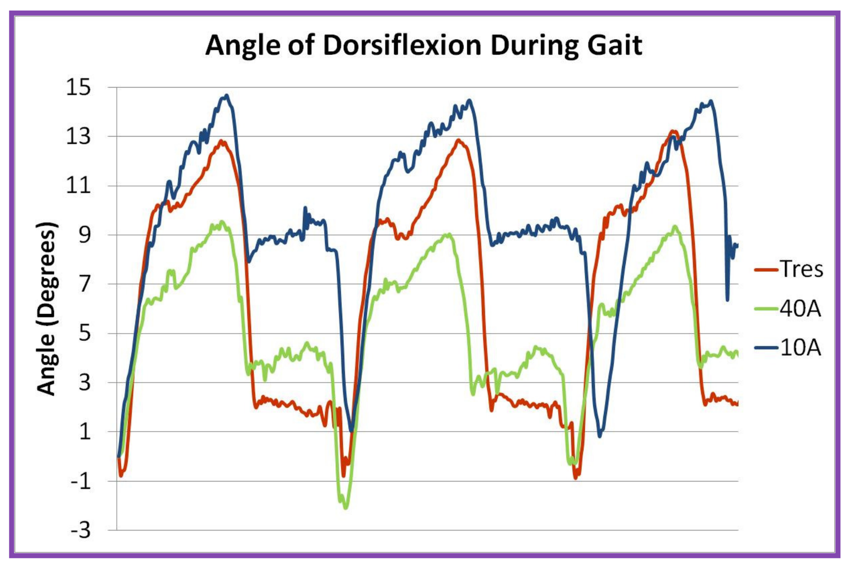












Discussion and Conclusion

Overview

- Foot complies with ISO BS EN 10328:2006 standards
- Costs under 10 US dollars
- Open source business model
- Has the potential to create employment in low income countries

Rubber Comparisons

- The displacement, energy return and stiffness of the Core were improved by the casings; but not to the level of the VariFlex. This came at the cost of worsening the energy absorption
- No one rubber improved all the properties

Market Comparisons

- Heel of the 40A behaved similarly to VariFlex; showing potential to be high performing
- Creep observed at the forefoot of 40A
- The Niagara was excessively stiff and the ICRC deformed too much; showing they were not high performing

Gait Analysis

- The GRF in the vertical and horizontal plane for the 10A and 40A were statistically similar to the Trés carbon fibre foot
- The GRF in the translateral plane for the Strathclyde Feet and Trés foot were statistically different

Future

- Test between Cores
- Standardise the position of the Core within the casing
- Test other casings
- Test using attachment that will be used with the foot
- Further clinical trials
- Cyclic and static proof testing

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