SHAPE & ROLL FOOT

Developing World Prosthetics

2/10/10

Motivation and Concept of Shape&Roll Design (Northwestern University)

Limitations of Jaipur Foot:

- Lacks toe support, leads to shortened step length and increased loading on contralateral side
- Discontinuous change in material from keel to surrounding foam/rubber leads to "drop-off" experience and may contribute to early deterioration
- approximately 800g

Goals:

- Introduce roll over shape (radius varies with height) of biological ankle-foot system
- Reduce weight without compromising durability

Jaipur Foot

Biological Foot

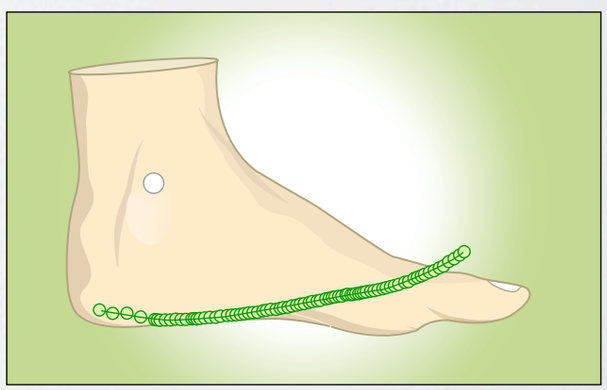

Image by MIT OpenCourseWare.

Image of Jaipur Foot courtesy of Dr. Pooja Mukul, Bhagwan Mahaveer Viklang Sahayata Samiti - Jaipur Foot Organization, Jaipur, India. Used with permission.

Design

- Cuts in forefoot
- Shock absorption in heel
- Stiffness varied by varying thickness of bottom plate (independent of roll over shape)
- Allows force-induced bending

Images of Shape and Roll Foot designs removed due to copyright restrictions.

Material

- 97% polypropylene, 3% polyethylene copolymer
- High fatigue resistance
- Acceptable stiffness
- Easily thermoformed
- Water resistant
- Low cost
- Lightweight (230g for size 10 foot)

Photo of Shape and Roll Foot from Prosthetics Research Laboratory and Rehabilitation Engineering Research Program at Northwestern University Feinberg School of Medicine has been removed due to copyright restrictions.

Manufacturing Process

- Pieces of copolymer polypropylene-polyethylene plastic are melted in oven
- Pieces then compressed using lever-molding machine used to make "blank" foot that can be customized for right and left feet of various size (22-29cm)
- Size and shape drawn on blank using templates, lines drawn on forefoot depending on height. Circle drawn to indicate location of hole for bolt
- Cuts made and aluminum insert pressed inside foot to strengthen attachment

Images of manufacture process for the Shape and Roll Foot have been removed due to copyright restrictions. For complete article, see Sam, M., D. Childress, A. Hansen, et al. "The Shape&Roll Prosthetic Foot (Part I): Design and Development of Appropriate Technology for Low-Income Countries." *Medicine Conflict and Survival* 20, no. 4 (2004).

Shape & Roll Redesign, DWP 2009

- Development of attachment to interface foot to exoskeletal prostheses (previously Shape & Roll only tested for endo-skeletal prostheses)
- Design for extreme dorsiflexion (to enable squatting)

Cosmetic Covering:Making a negative mold of a foot using clay

Images of manufacturing cosmetic shells removed due to copyright restrictions. For complete article, see Hansen, Andrew, et al. “Technique for Manufacturing Low-Cost Prosthetic Foot Shells”. Submitted to Journal of Rehabilitation Research and Development (2008).

Cosmetic Covering: examples of foot shells

- The polyurethane can be dyed to reflect different skin tones.
- The cost of the mold is estimated to be $35-60, while the cost of the prosthetic shell is about $5.

Images of manufacturing cosmetic shells removed due to copyright restrictions. For complete article, see Hansen, Andrew, et al. "Technique for Manufacturing Low-Cost Prosthetic Foot Shells". Submitted to Journal of Rehabilitation Research and Development (2008).

Project Goal: Improving Cosmetic Covering for the Shape&Roll Foot

- Maintain functionality of roll-over shape (cuts)
- Better toe support
- Smoothness between keel and rubber
- Resistant to water and wear
- Inexpensive, available materials

References

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- Hansen, A.; Meier, M.; Steer, S., Sam, M.; Dussud, S.; Wu, Y.; Childress, D. "Technique for Manufacturing Low-Cost Prosthetic Foot Shells". Submitted to Journal of Rehabilitation Research and Development. February, 2008.
- Sam, M., Childress, D., Hansen, A., Meier, M., Lambla, S., Grahn, E., Rolock, J. (2004) The Shape&Roll Prosthetic Foot (Part I): Design and Development of Appropriate Technology for Low-Income Countries. Medicine Conflict and Survival, Vol. 20, No. 4, 294-306.
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SP.733 Special Topics at Edgerton Center:Developing World Prosthetics

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