Quantification of Transfemoral Prosthetic Socket Fabrication

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Background

Prosthetic socket fabrication is typically a specialized process heavily dependent on the craftsmanship skill of the prosthetist. Efficient knowledge dissemination and automation of the fabrication process requires quantification of this process.

Purpose of the Study

To quantify the specialized process of fabricating sockets for highly active persons with transfemoral amputations (TFA).
A. Quantify clinical (pre- and post) rectifications
B. Quantify the socket (frame) development process

Introduction

Transfemoral Prosthesis Orientation

• Suspension
• Interface
• Components

Typical Transfemoral Socket Fabrication Process

Casting & Negative Mold
Positive Mold Rectifications
Assemble Components
Fabricate Socket
Check Socket

Method/Results

A. Quantifying Clinical (Pre- and Post) Rectifications

- Vacuum assisted suspension
- Lower sub-ischial proximal trimlines
- 4-Stage lamination procedure
- Optimized frame geometry to increase socket flexibility

Methods/Results

Novel Sub-Ischial Transfemoral Socket

- Prevalence: General 20% (Owings, 1998)
- Service persons with amputations
  - Generally young and extensively trained
  - Have high expectations of their function with prostheses

Relevance to Military Medical Care

- Military 31% (Stansbury, 2008)

Results: Rectification Patterns

A. Quantifying the Socket (Frame) Development Process

3-D scanned and CAD model
Finite Element Model
Parameterized model geometry and thicknesses

Results: Stress Distribution Patterns

Anterior
Lateral
Posterior
Medial

Conclusions

The majority of the rectifications are in the proximal lateral portion of the cast. Preliminary results demonstrate that different frame geometries have different effects on the socket stress distribution.

Implications/Applications

- Technology assisted fabrication (CAD/CAM, rapid prototyping, etc.)
- Facilitates knowledge dissemination of specialized techniques

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