Bicycle Setup and Prosthesis Design for Cyclists with Amputation

Lee Childers PhD MSPO certified prosthetist
lchilders@alasu.com

Introduction

- Overview
- Cycling goals
- Riding the bike
- Simulate amputee cycling
- Bike setup
- Prosthesis design recommendations

Cycling goals

- Recreational
  - Use regular prosthesis
- Competitive
  - Cycling specific prosthesis


Riding the Bike

- Confidence
- Getting on/off
- Starting/stopping

Simulation

- Use a prosthesis
  - Transtibial
  - Most transfemoral
- Do not use a prosthesis
  - Extremely short transfemoral
  - Hip Disarticulation

• Use regular prosthesis
• Cycling specific prosthesis

• Recreational
• Competitive

• Do not use a prosthesis
• Use a prosthesis

• Confidence
• Getting on/off
• Starting/stopping
Riding the Bike

- Sound limb
  - Last On
  - First Off
- Start slow
  - Off/on drills
  - Start/stop drills

One Legged Cycling

- Start with fixed gear
- Learn the bike
- Graduate to geared bike

Bike Setup

- Work with a Bike Fitter
  - Trek
  - Serotta
  - Specialized

Bike Setup

- Saddle Height = Greater Trochanter to Floor – 1 to 2 cm
- Knee should be about 150 degrees at the bottom of the pedal stroke.

Attaching the shoe to the pedal

- BMX Pedal
- Velcro
- “Clipless” pedal systems

Attaching the shoe to the pedal

- “Clipless” pedal systems
Using “Clipless” Pedals


Heel/Crank Clearance


Asymmetrical Crank arms

- “Corrects” kinematic asymmetries
- Does NOT change kinetic asymmetries
- Shifts joint work from knee to hip

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Cycling Prosthesis Design

- Prosthetic foot
  - STIFF AS POSSIBLE

Childers W.L. Motor control in persons with a transtibial amputation during cycling. School of Applied Physiology, Georgia Institute of Technology, 2011.

Childers W.L. Prosthetic foot stiffness in persons with a transtibial amputation during cycling. School of Applied Physiology, Georgia Institute of Technology, 2011.
TT Cycling Prosthesis Design

• Alignment
  – A-P
    • Start with cleat at 1st metatarsal head
    • Moving cleat posteriorly
      – Lengthen prosthesis
      – ↑ Hip work
      – ↓ Knee work
      – ↑ Hamstring use


TT Cycling Prosthesis Design

• Alignment
  – M-L
    • Knee motion should be a straight line
    • Knee motion should match sound limb

What is Optimal?

TT Cycling Prosthesis Design

• Trimlines
  – Posterior wall
    • Careful how much you cut down!
  – Medial/Lateral
    • Extend just proximal to apex of femur epicondyle

Cycling Prosthesis Design

• Suspension
  – Pin/lanyard
  – Suction (TT)
    • Seal in liner
    • Valve that allows user to bleed off suction

TF Cycling Prosthesis Design

• Knee joint
  – No dampening
  – Single axis
  – Knee flexion stop
  – Extension assist?
  – Location?
TF Cycling Prosthesis Design

One Legged Cycling

Allison Jones, US Paralympian

Summary

- Cycling goals
- Simulate amputee cycling
  - TRY IT BEFORE YOU TEACH IT!
- Bike setup
  - Professional Bike Fitter
- Riding the bike
  - Rider Confidence
  - Starting/stopping