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Upper Limb Prosthetic Rehabilitation for Occupational Therapists: understanding technology

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M.Ed. Advanced Practice of Occupational Therapy; OTR/L

Disclosures

- Consumer
- Clinician
- Contributor
- Consultant
Disclosures

- **Financial:**
  - Receives payment for this series
  - Owner, Single-Handed Solutions, LLC
  - Inventor of record of patented prosthetic technology and method of use
  - Business relationship with TRS, Boulder, CO
  - Business relationship with Handspring, Middletown, NY
  - Business relationship with Liberating Technologies Inc., Hopkinton, MA
  - Business relationship with Shriners Hospitals for Children
    - owner of patented technology mentioned in the series

- **Non-financial**
  - Member, Upper Limb Advisory Council, Amputee Coalition of America (ACA)
    - services mentioned in the presentation
  - Member, Association of Children’s Prosthetic Orthotic Clinics (ACPOC)
    - services mentioned in the presentation

Learning Objectives

- By the end of the course, the participant will be able to identify the different types of prosthesis.
- By the end of the course, the participant will be able to list the components of each type of prosthesis.
- By the end of the course, the participant will be able to recognize which type of prosthesis would be indicated in different situations.
OT

- Critical component of UL prosthetic rehabilitation
- Rarely see an individual with an UL amputation
- Often unfamiliar with UL prosthetic technology
- Specialty training is beneficial

OT

- Limb preparation
- Adjustment-Accommodation
- Prosthetic training
  - specific tasks
  - motor skills
  - positioning
  - posture
- Accelerates the rehabilitation process
- Essential to success in functional independence and achieving quality of life.
Understanding Technology

It is the second in a series building upon a foundation of understanding
• the types of limb deficiency/loss
• the diverse technologies available
• approaches to evaluation and management
• patient education and consumer advocacy

A look at the past

• [http://www.bbc.co.uk/news/health-16599006](http://www.bbc.co.uk/news/health-16599006)
## History and advancements

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### The Hand

- Complicated
- Multi-functional
- 27 degrees of freedom
- **Active function** = generate high forces
- **Passive function** = resist high loads  
  - (weight bearing)
- Muscle & Bone structures
- Challenging to replicate with singular technology
“No single prosthesis can address the multiple deficits associated with upper limb loss...”

TECHNOLOGY OPTIONS

- No Technology
- Preparatory
- Passive Aesthetic Functional
- Activity-Specific
- Body-Powered
- Externally-Powered
- Hybrid
FACTORS

• Weight
• Cosmesis
• Harnessing
• Sensory Feedback
• Dexterity
• Repairs / Replacement
• Cost
• New Developments

TECHNOLOGY components

• Suspension System
• Socket
• Joints
• Terminal Device
• Power Source
• Control Source
No technology

• Adaptive Strategies
• Assistive Devices

NATURAL
INDIVIDUALLY ADAPTIVE
? IMPACT OF SOCIAL STIGMA
Passive Aesthetic Functional

- Pediatrics
- Adults
Passive Aesthetic Functional

- Static Hand
  - Limb Length
  - Appealing
  - Weight-bearing
- Manually Movable
  - “Grasp”
  - Appealing
  - Positioning

Function
Social Acceptance

Activity-Specific

- Specific to diverse activities/tasks
- Typically passive, assistive in nature
- Self-care
- Recreation
  - Sports
  - Music
  - Other
Activity-Specific

- Must attach securely to residual limb
- Must allow free ROM
- Must be able to get wet
- Must be able to grip the paddle, rotate and flex to follow the stroke allowing the ability to pull, push and feather the paddle.
- Emergency release
Body-Powered

- Gross movement to control TD
- Sensory feedback
- Robust
- Functional envelope may be limited
  - Impact of harnessing

Body-Powered

- Hook
- Hand
- CAPP
- ADEPT
- Lite Touch
Body-Powered

**VOLUNTARY OPENING**
- Work to open
- Strength: Elastic Bands
  - 1-1.5 lb/band
- Split hook
- APRL hand

**VOLUNTARY CLOSING**
- Work to close
- Strength: User
- Lite Touch
- Adept

---

**Body-Powered**

- Voluntary Open
Body-Powered

- Voluntary Close

Harness SUSPENSION

- Shoulder/Trans-Humeral
Harness styles

- Contralateral anchor
- Asymmetry
- Overuse
- Strategic Motor Planning

Harness SUSPENSION

Figure of Eight  Figure of Nine

[Images of harness styles and suspension methods]
Operation - BP AE Prosthesis

- Elbow Lock
  - Humeral Extension
- Forearm Control
  - Humeral Flexion with Elbow Unlocked
- Terminal Device
  - Humeral Flexion with Elbow Locked

Operation – BP BE Prosthesis

- Body Powered Hook or Hand
  - Humeral Flexion
  - Scapular Abduction
Cutaneous anchor SUSPENSION

Trans-Radial

Trans-humeral

Traditional and Anchor
Supracondylar suspension

Muenster
Pin-Lock Liner

Neoprene sleeve suspension
Externally-Powered

Muscular Contraction

Types
  – Cookie Cruncher
  – One Site
  – Dual Site

New Technologies
  – MORPH
  – Pattern Recognition
MYOELECTRIC TERMINAL DEVICES

Utility

Hand

“Smart” technology
NEW DEVELOPMENTS

Pattern Recognition
• Constellation of sites
• Reads pattern(s) of signals
• Relative to grasp patterns
• Intuitive to person
• Program/re-programmable

Tag System
• Pre-selected grasp patterns
• Programmed tags
• Strategic placement
• Task-specific
• Multiple tags/sites

Pattern Recognition

COAPT System

continued
Tag System

MORPH

Joints

- Shoulder
  - Body Powered
  - Myoelectric

- Elbow
  - Body Powered
  - Myoelectric

- Wrist
  - Constant Friction
  - Flexion Wrist
  - Quick Disconnect
Myo-electric Elbow

- Microswitch
  - Shoulder Depression
- Touch Pads
- Myoelectric Electrodes

Hybrid
BILATERAL INVOLVEMENT

QUESTIONS

• What are the requirements of the tasks and activities?
• What are the environment factors?
• What are the advantages/limitations of each device?
• What are the limits of the technology?
• How does it limit or enhance ROM?
• How does it suspend from the limb?
• Can it endure heat, water or other physical stress?
• Is a quick-release available?
• Is the manufacturer able to work toward custom design?
The process

- Measurements
- Molding
- Check Socket
- Preparatory
- Final Fabrication
- Check-Out

MEASUREMENTS

- Limb length
- Circumference
MOLDING

- Plaster
- Alginate
- Silicone
- Fiberglass

PREPARATORY

- Important step to assess fit and features
- Modifications
PREPARATORY

• Check socket
• Additional modifications

DEFINITIVE

• The Final Touches
DELIVERY

- Check-out of fit
- Instruction to donning, doffing
- Instruction to care, cleansing
- Instruction to control

Payment sources

- Private Insurance
  - One Prosthesis for Lifetime
  - DME Cap
  - Full Cost
  - Full Cost After Deductible
- 20-40% use health insurance
Alternative Payment sources

• Government Assistance Programs
  – Crippled Children’s Services
  – Medicaid
• Private Philanthropic Groups
  – Variety Clubs
  – Shriners Hospitals for Children, other
• Community Fund Raising

Foreign Country Policies

• Australia
  – Free Until 1990
  – 15% of Cost to Maximum of $200/pt/yr.
• Denmark
  – Free Care
• UK
  – National Health Services
  – No Charge
Questions

Manufacturer Resources

COAPT Engineering
Fillauer
Infinite Biomedical Technologies
Liberating Technologies
Livingskin
Motion Control
Otto Bock
RSL Steeper
Texas Assistive Devices
Touch Bionics
TRS Prosthetics
Vincent Systems

coopengineering.com
fillauer.com
i-biomed.com
liberatingtech.com
touchbionics.com
utaharm.com
ottobockus.com
steeperusa.com
n-abler.org
touchbionics.com
trsprosthetics.com
vincentsystems.de
References

1. Atlas of Amputations and Limb Deficiencies, edited by Douglas G. Smith, MD, John W. Michael, MEd, CPO, and John H. Bowker, MD (Specific chapters by Thomas Passero, CP, Kim Doolan, John R. Fisk, MD, and Douglas G. Smith, MD, Joan E. Edelstein, MA, PT, and Donald R. Cummings, CP, LP.


References


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