



# Advancement in Prosthetics

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*Owner*

Macy O&P

# INTRODUCTION

David Gray, CPO



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# Difference Between Professions

- Certified Orthotist-Prosthetist VS Brace/DME Sale Reps
  - Education
  - Training
  - Treatment Flexibility & Product Choices



## WHAT IS AN ORTHOSIS?

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## BRIEF HISTORY OF ORTHOTICS

- The simplest definition of an orthosis is any externally applied device to an existing body part that improves function. Common goals include:
  1. Stabilize weak or paralyzed segments or joints
  2. Support damaged or diseased segments of joints
  3. Control abnormal or spastic movements
  4. Prevent further progression or additional injury



# TYPES OF ORTHOTICS

## UPPER EXTREMITY ORTHOTICS

- ARM SLINGS
- FRACTURE TREATMENT / IMMOBILIZATION
- WRIST BRACES





# WHAT IS AN ORTHOSIS?

## LOWER EXTREMITY ORTHOTICS

- KNEE BRACES – OA, ligament injuries, meniscal tears, patella subluxation – common prescriptions that don't treat these conditions.
- AFO - Nerve injuries/drop foot - AFO
- CAM BOOTS - Ankle Fracture
- ORTHOPEDIC SHOES/INSERTS –

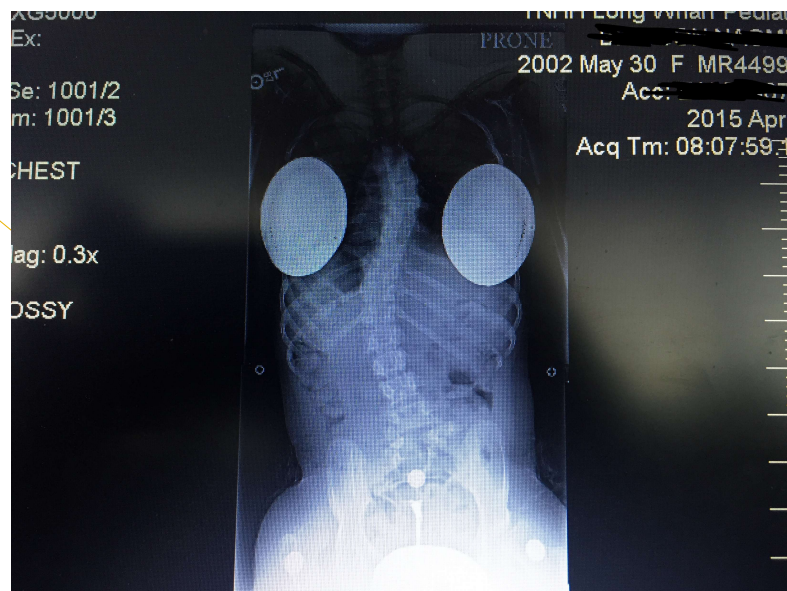
\*\*Prefabricated VS Custom



# WHAT IS A ORTHOSIS?

## SPINAL ORTHOSIS

### WITHOUT BRACE



### WITH BRACE





# WHAT IS AN ORTHOSIS?

## PREFABRICATED PROS AND CONS

### PROS

- Less expensive
- Lots of styles and sizes
- Can be stocked and patient treated quickly
- Promote Healing

### CONS

- Not very durable
- Bulky
- Low Quality material
- Problem fitting different types of anatomy
- Can promote weakness

# WHAT IS AN ORTHOSIS?

## CUSTOM PRO AND CONS

### PROS

- Very durable
- Custom to fit all types of anatomy
- Control types of material used
- Higher chance of compliance
- Promote Healing

### CONS

- Expensive
- Longer treatment time due to fabrication
- Can promote weakness



**WHAT'S NEW?**

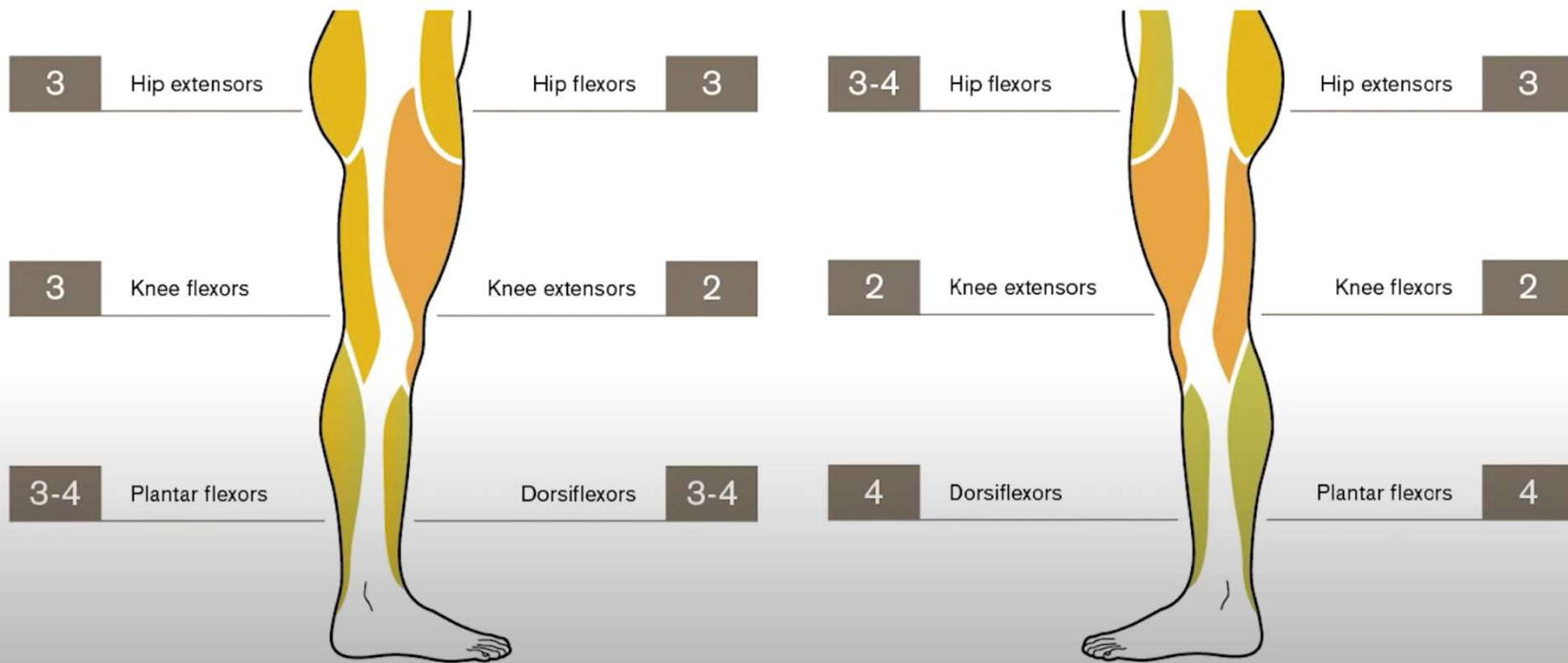
# C-BRACE

## MICROPROCESSOR ORTHOSIS

The first KAFO (Knee Ankle Foot Orthosis) that allows users to flex their leg under load (example: sitting down), and to navigate slopes, walk on uneven terrain or descend stairs step over step.



### Muscle strength (Janda)





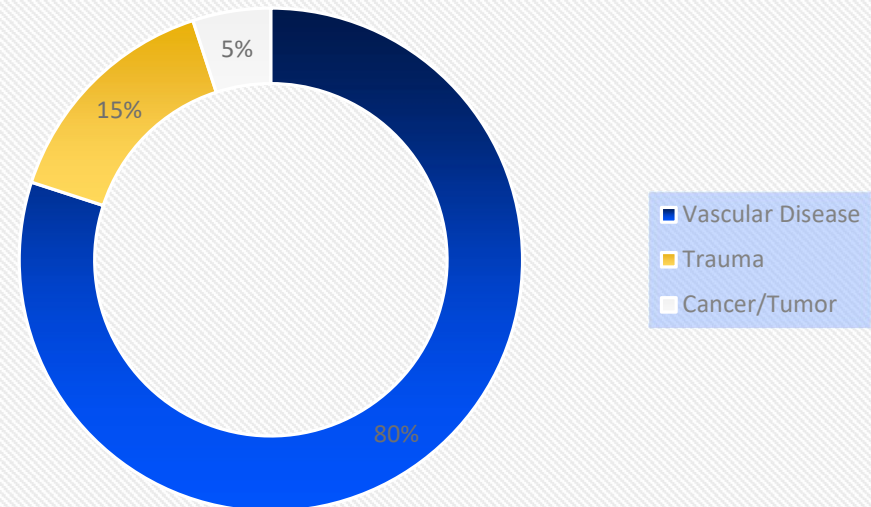


# PROSTHETIC CARE

# AMPUTATIONS IN THE AMERICA

- Over 150,000 people undergo amputations of the lower extremity in the United States each year
- The most common causes leading to amputation are diabetes mellitus, peripheral vascular disease, and neuropathy.
- Patients with diabetes mellitus have 30 times greater lifetime risk of undergoing an amputation when compared to patients without diabetes mellitus
- Economic strain in healthcare systems of over \$4.3 billion in annual costs in the USA alone

Amputations in the United States



# TYPES OF PROSTHETICS

LOWER EXTREMITY PROSTHESIS

MICROPROCESSOR KNEES/FEET

RUNNING FEET

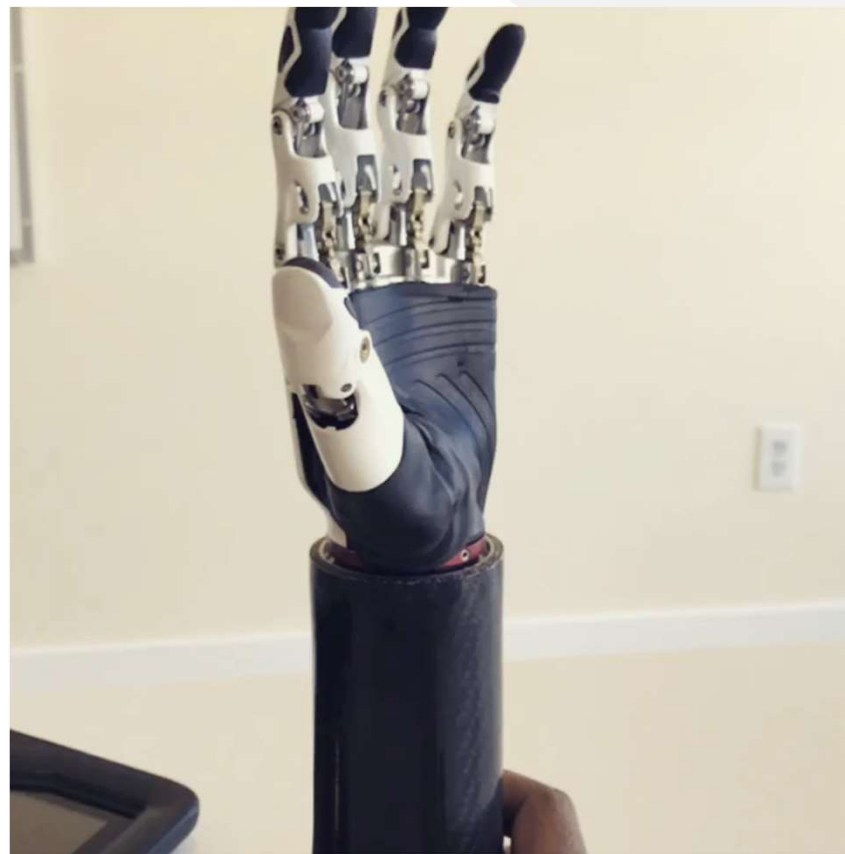
SWIM FEET/SHOWER LEG



# TYPES OF PROSTHETICS

## UPPER EXTREMITY PROSTHESIS

- HAND PROSTHETICS
- BELOW/ABOVE ELBOW PROSTHETICS
- SHOULDER DISARTICULATIONS





# WHO'S A CANDIDATE FOR PROSTHETIC LIMBS?



# WHO'S A CANDIDATE FOR PROSTHETIC LIMB?

- AGE
- STRENGTH
- ACTIVITIES OF DAILY LIVING (ADL)
- K-LEVEL (PARTICULARLY USED FOR LOWER EXTREMITY PROSTHETICS)

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# WHO'S A CANDIDATE FOR PROSTHETIC LIMB?

- LOWER EXTREMITY

- K-0-The patient does not have the ability or potential to ambulate or transfer safely with or without assistance and a prosthesis does not enhance their quality of life or mobility
- K-1-The patient has the ability or potential to use a prosthesis for transfers or ambulation on level surfaces at fixed cadence or speed. This is typical of a household ambulator or a person who only walks in their own home.
- K-2-The patient has the ability or potential for ambulation with the ability to traverse low-level environmental barriers such as curbs, stairs or uneven surfaces. This is typical of the limited community ambulator
- K3-The patient has the ability or potential for ambulation with variable cadence or multiple speeds. A person at level 3 is typically a community ambulator who also has the ability to traverse most environmental barriers and may have vocational, therapeutic or exercise activity that demands prosthetic use beyond simple locomotion
- K-4-The patient has the ability or potential for prosthetic ambulation that exceeds basic ambulation skills, exhibiting high impact, stress or energy levels. This is typical of the prosthetic demands of the child, active adult or athlete

# LIFETIME NEED FOR A PROSTHESIS

- Like the maintenance of any mechanical equipment, prosthetics will require consistent replacement of components for the lifetime of the patient.
  - Patient loses or gains weight
  - Growth
  - Changes in K-level or function
  - Changes in Job/Career requirements
  - Wear and tear of liners, socks, sockets, skin/foam covering

***\*\*there is always a need to replace the socket several times within the first 2 years at minimum***

# LIFETIME NEED FOR A PROSTHESIS

- OTHER FACTORS TO CONSIDER
  - NEW TECHNOLOGY
    - PROSTHETIC FEET
    - PROSTHETIC KNEES
    - SOCKET DESIGN AND MATERIALS (example: prosthetic liners)
  - ACTIVITY SPECIFIC PROSTHESIS
    - SHOWER/SWIMMING LEG
    - WORK LEG VS HOME LEG
      - Mechanical vs Computerized/Microprocessor



# FUNDING OF PROSTHETIC DEVICES



# FUNDING COVERAGE

## PRIVATE SECTOR

- **PROS**

- Multiple O&P locations and providers
- Can be prescribed anywhere (physician close to where the patient lives)

- **CONS**

- Detailed medical justification required
- Not all insurances cover advance prosthetics including activity specific
- High Deductibles/Co-pays

## GOVERNMENT SECTOR

- **PROS**

- Don't have to deal with insurance requirements
- No Cost to patient

- **CONS**

- Hospital facilities are limited depending wear you live.

# FUNDING & COVERAGE

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## OFF CODES/999 CODES

- DIFFERENCE IN CODES AND COST
- DIFFERENCE BETWEEN O&P AND STANDARD DME



# **YOUR EXPERIENCE WITH PROSTHETICS**

- HAVE YOU EVER RECEIVED A REQUEST FOR ORTHOTIC AND PROSTHETIC CARE?
- CONTRACTED PROVIDERS VS PREFERRED PROVIDER VS PATIENT CHOICE
- HOW DO YOU DECIDE WHETHER TO COVER THE CARE OR NOT?



**WHAT'S NEW?**

# EWING AMPUTATION

- The Ewing Amputation preserves normal signaling between the muscles and the brain
- The Ewing procedure maintains natural linkages between muscles in an amputated leg
- Amputees feel as if they are controlling their physiological limb, even though it's been replaced by a prosthesis





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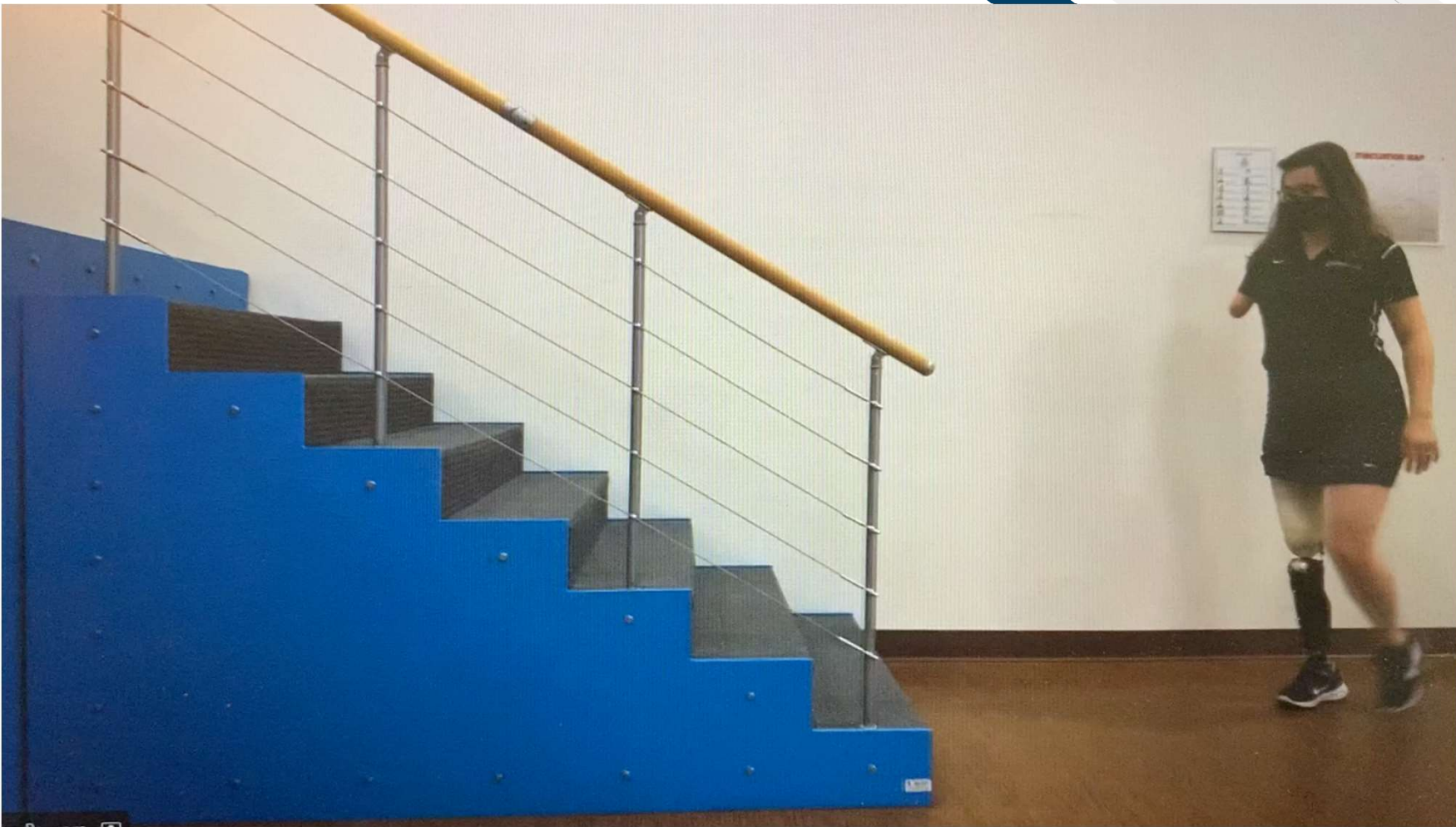
# POWER PROSTHETICS

## POWER KNEE



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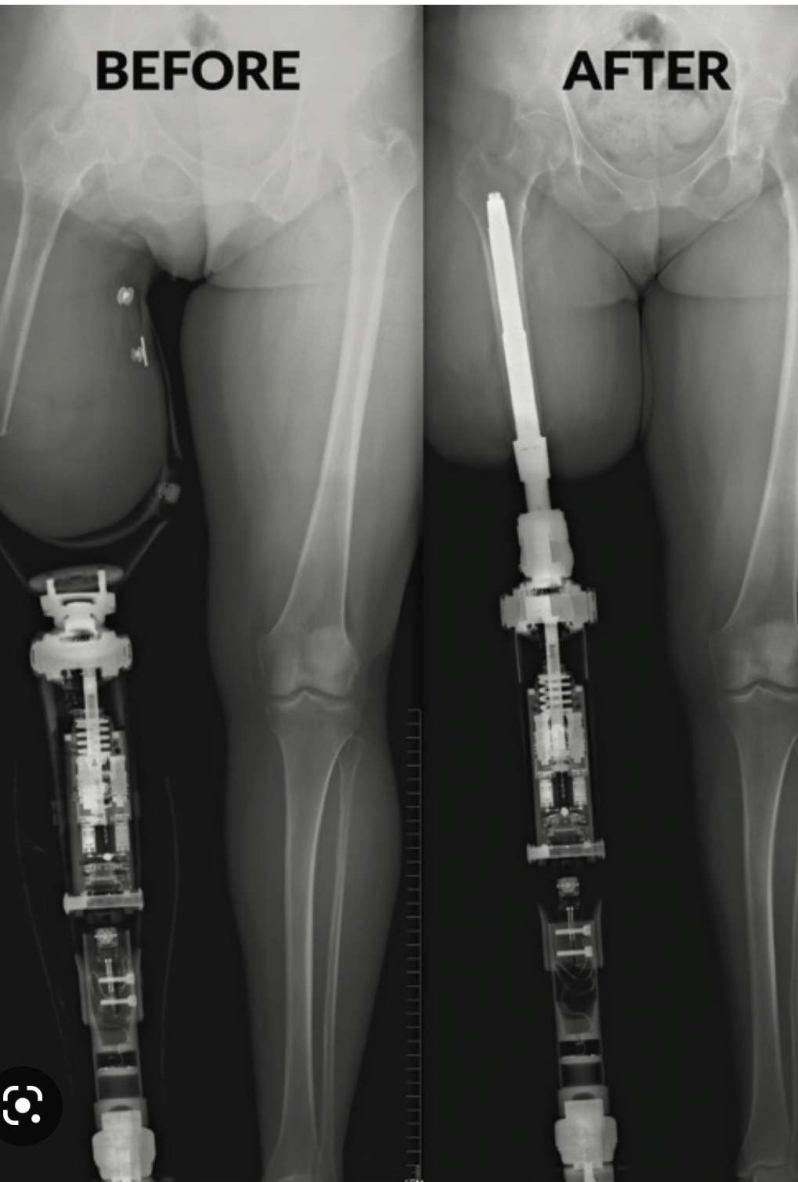


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# OSSEOINTERGRATION PROSTHETICS



- Osseointegration is a surgical procedure that aims to offer better quality of life and improved function and mobility to people who have had an amputation. Surgery involves inserting a metal implant into the bone of a residual limb, which then attaches directly to a prosthesis, eliminating socket-related issues. Surgery can be performed in one or two stages, depending on the implant system.

# ..Point Designs

## PARTIAL HAND PROSTHETICS

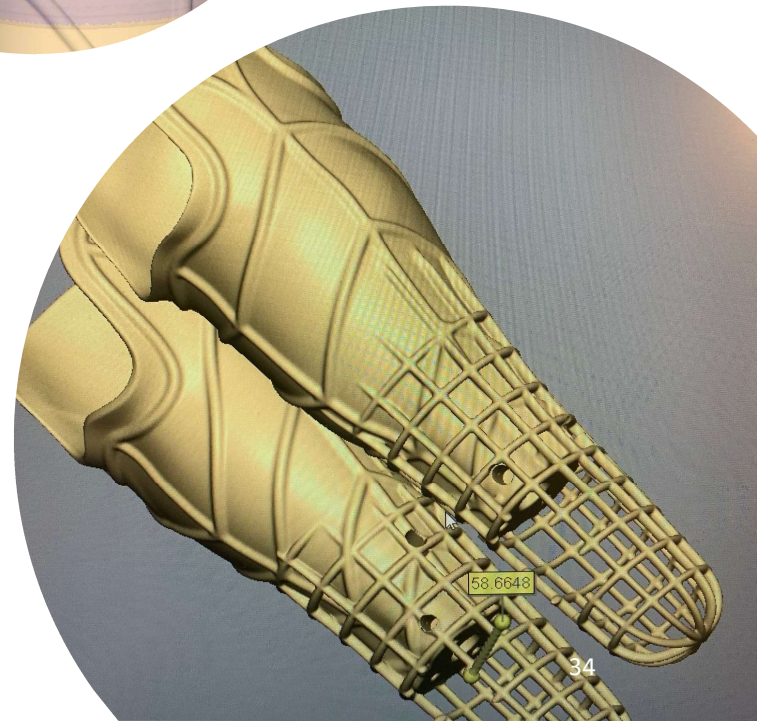
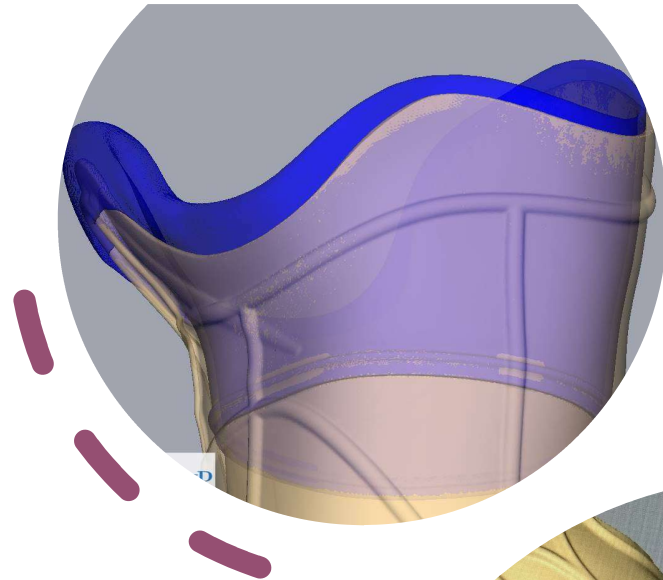
- FUNCTIONAL CARE
  - *OSSUR DIGITS*
  - *POINT DESIGNS*
- PSYCHOSOCIAL CARE
  - *CUSTOM SILICONE RESTORATIONS*



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# 3D PRINTING

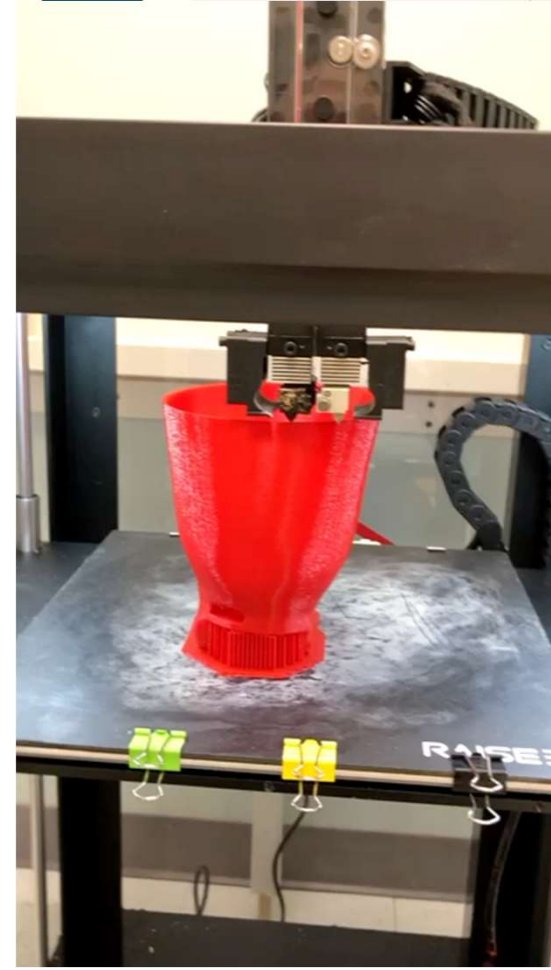
- CAD DESIGN HAS BEEN AROUND FOR DECADES BUT THE ABILITY TO PRINT AND DESIGN THE ACTUAL DEVICE IS RELATIVELY NEW WITHIN THE PAST 5 YEARS.
- FIRST 3D PRINTED SOCKET WAS OVER 25 YEARS. BUT THE 3D PRINTER HAS EVOLVED TO BECOME ECONOMICALLY FEASIBLE TO PRACTICES/CLINICS.





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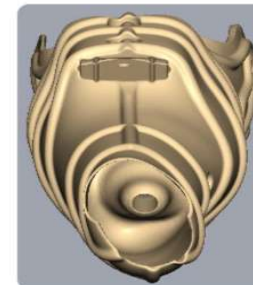
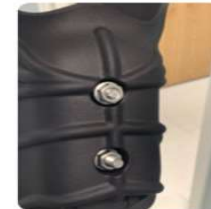
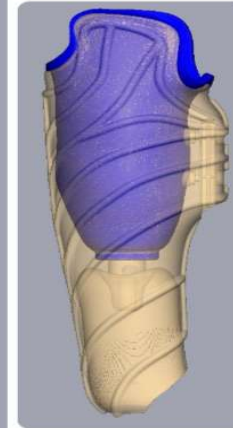


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Continuous  
but hollow  
shell under the  
socket pin  
lock / limb!



# 3D PRINTING

- PROS

- More accurate design
- Repeatable
- Quantify change better than conventional methods
- Detailed database of limb and alignments history
- Practitioner can spend more time with the patients
- Streamlined lab requirements/No need to outsource
- Can design and manufacture devices/features that are impossible to make by hand
- Minimizes transfer/handoff errors or miscommunication during fabrication

- CONS

- Size limitations depending on size and type of printer



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# PATIENT MODEL & DEMONSTRATION

# QUESTIONS?



# REFERENCES

*Krajchich, I., Pinzur, M. S., Potter, B. K., & Stevens, P. M. (2018). Atlas of Amputations & Limb Deficiencies, 4th edition. Lippincott Williams & Wilkins.*

*Hsu, J. D., Michael, J. W., Fisk, J. R., & American Academy Of Orthopaedic Surgeons. (2008). AAOS atlas of orthoses and assistive devices. Mosby/Elsevier.*

*Reengineering the Ewing Procedure for Upper-Limb Amputation - Brigham and Women's Hospital. (n.d.).*  
*Www.brighamandwomens.org. Retrieved March 8, 2023, from*  
<https://www.brighamandwomens.org/campaigns/physicians/reenginerring-ewing-procedure-for-upper-limb-amputation>

*Molina, C. S., & Faulk, J. (2020). Lower Extremity Amputation. PubMed; StatPearls Publishing.*  
<https://www.ncbi.nlm.nih.gov/books/NBK546594/>

*Gait cycle - Comparison with and without C-Brace® & Nexgear Tango | Ottobock. (n.d.).* Wwww.youtube.com.  
Retrieved March 27, 2023, from <https://www.youtube.com/watch?v=gH3tAl5bgmc>

*C-Brace® KAFO | Step into your future.™. (n.d.).* Wwww.ottobock.comundefined. Retrieved March 27, 2023, from [https://www.ottobock.com/en-us/product/17KO1000=0\\_B](https://www.ottobock.com/en-us/product/17KO1000=0_B)

# REFERENCES

*Power Knee™ | A New Era in Motion.* (n.d.). Www.ossur.com. <https://www.ossur.com/en-us/prosthetics/explore-power-knee>





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**Thank You!**