


SCOREBUILDERS



SPOTLIGHT Series

**Prosthetics Review
for the NPTE**

*Presented by
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Purpose

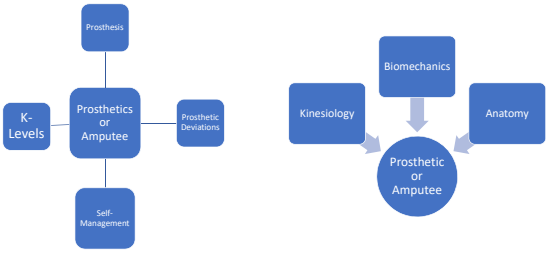
1. Identify areas of focus for your study plan.
2. Draw parallels between other content areas and prosthetics.
3. Prepare you for prosthetics content that could be encountered on NPTE.

NOT

1. Comprehensive course on prosthetics (but covers a lot!).
2. Rehash of Scorebuilders book.

2

Parallels?



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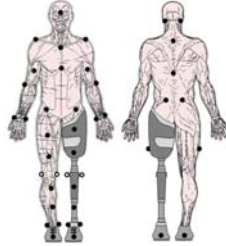
    graph TD
      A[Prosthetics or Amputee] --- B[Prosthesis]
      A --- C[Prosthetic Deviations]
      A --- D[Self-Management]
      A --- E[K-Levels]
      F[Prosthetic or Amputee] --- G[Biomechanics]
      F --- H[Kinesiology]
      F --- I[Anatomy]
  
```

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General: Areas of Focus

I cannot guarantee anything, but if I were writing questions...

- Prosthetics (2-5 Q's)
 - Transtibial/transfemoral level amputation
 - Gait deviations
 - Biomechanics
 - K-levels
 - Preventing complications
 - Phantom pain
 - Red-flags



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General: Unlikely Topics

- Cant ask manufacturer specific questions
- Cant ask about suspension systems beyond basics
- Cant make assumptions on stages of healing
- Random facts about prostheses, components, or sockets

What are some of the specification differences between Genium™ and C-Leg™?

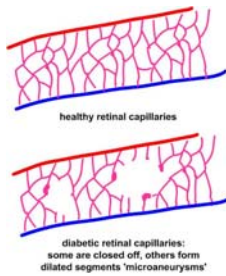
Specification	Genium	C-Leg™
Knee Weight	2.8 lbs	3.4 lbs
User Weight Range	100 lbs	175 lbs
Maximum Flexion	135 degrees	135 degrees
Range of Motion	Approximately 9 steps	Approximately 40-45 steps
Operating Modes	Flexion with 3 different modes	Flexion with 3 different modes
Warranty	2 years + 2 year optional extension	2 years + 2 year optional extension



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General: Terminology

- Person/individual with limb loss
- Limb difference
- Dysvascular
- Residual limb
- Prosthesis
- Prosthetic limb
- Prosthetic/prosthesis user



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General: Terminology

The image contains two anatomical diagrams. On the left, a diagram of a foot shows three levels of amputation: Syme's (at the ankle), Chopart's (at the midfoot), and Lisfranc's (at the tarsometatarsal joint). A Transmetatarsal amputation is also indicated. On the right, a diagram of a human figure shows levels of upper and lower limb amputations. Upper limb levels include Forequarter Amputation, Shoulder Disarticulation, Transhumeral (above elbow), and Transradial (below elbow). Lower limb levels include Hip Disarticulation, Transfemoral (above knee), Knee Disarticulation, and Transtibial (below the knee). Foot Amputation is also shown.

<https://musculoskeletalkey.com/ideal-functional-outcomes-for-amputation-levels/>

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General: Etiologies

- Upper limb
 - Traumatic
 - Commonly digits
- Lower limb
 - Non-traumatic
 - Dysvascular
 - TT most common

Figure 1.1 shows a human silhouette with various amputation levels marked and their corresponding percentages:

- Through Shoulder (Shoulder Disarticulation) / Forequarter: 1.5%
- Above Elbow (Transhumeral): 4%
- Through Elbow (Elbow Disarticulation): 0.5%
- Below Elbow (Transradial): 8%
- Hand amputations: 2%
- Through Hip (Hip Disarticulation) and hemipelvectomy: 2%
- Above Knee (Transfemoral): 31%
- Through Knee (Knee Disarticulation): 1%
- Below Knee (Tibial): 47%
- Through Ankle (Symes or Ankle Disarticulation): 3%

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General: Anatomy of a Prosthesis

The image shows diagrams of upper and lower limb prostheses. The upper limb diagram labels the SOCKET, ROTATOR, and KNEE JOINT. The lower limb diagram labels the PILON and FOOT. Below these are images of various prosthetic components, including sockets, pylons, and feet.

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General: Prosthetic Sockets (LL)

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General: Suspensions

- **Transtibial:**
 - Suction
 - Triple SSS
 - Vacuum
 - Pin (shuttle lock)
- **Transfemoral**
 - Lanyard
 - Suction
 - Vacuum
 - Skin
 - Elastic belt

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General: K-levels

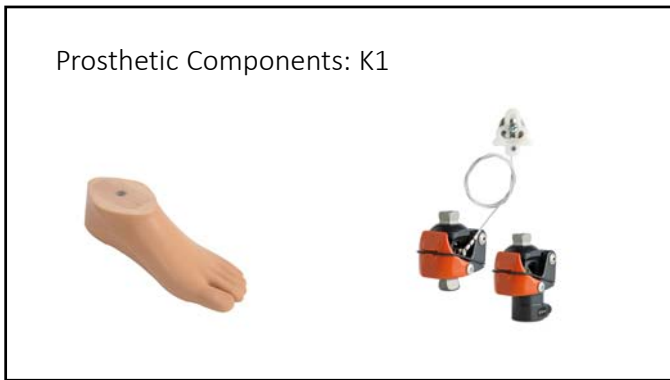
- How they are determined
 - Prior level of function
 - Current function
 - Perceived future level of function

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Medicare K-Level Guidelines

K level	Description	Knee (for TF only)	Foot/ankle system
0	<ul style="list-style-type: none"> Prosthesis will not enhance QoL or mobility potential. 	N/A	N/A
1	<ul style="list-style-type: none"> Transfers. Ambulate on level surfaces Fixed cadence Limited or unlimited household ambulator. 	<ul style="list-style-type: none"> Single axis 	<ul style="list-style-type: none"> SACH Single axis
2	<ul style="list-style-type: none"> Traverse low level barriers: curbs, stairs, uneven surfaces. Limited community ambulator. 	<ul style="list-style-type: none"> Poly-centric 	<ul style="list-style-type: none"> Flexible-keel Multi-axial
3	<ul style="list-style-type: none"> Variable cadence ambulator. Unlimited community ambulator. Traverse most environmental barriers. Prosthetic use beyond simple locomotion 	<ul style="list-style-type: none"> Hydraulic/pneumatic Microprocessor 	<ul style="list-style-type: none"> Dynamic response Multi-axial microprocessor
4	<ul style="list-style-type: none"> Exceeds basic ambulation skills. Exhibits high impact, stress, or energy levels. Typical of child, athlete, or active adult. 	<ul style="list-style-type: none"> Any system 	<ul style="list-style-type: none"> Any system "blades"

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Prosthetic Components: K3



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Prosthetic Components: K4



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General: Timeline

- Acute care= 1 wk
- Acute rehabilitation Vs sub-acute vs home
 - Acute rehab= 2 wks
 - Sub-acute= 20 days to 7 days
 - Actually becomes prosthetic training
 - Home: homecare based
- Generally pt is ready for a prosthesis after 6-10 weeks
 - Wound has healed and sutures are removed.
 - Prosthesis can be cast and manufactured
- Outpatient PT= Once patient receives prosthesis

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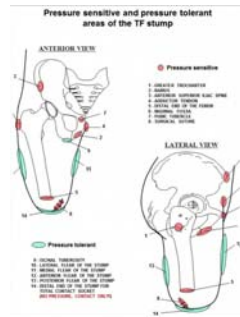
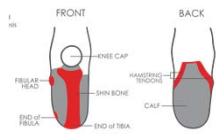
General: Rehabilitation Considerations

- Post-op
 - Protect limb
 - Shape limb
 - Prevent infection
 - Allow wound to heal
 - Desensitize
 - Pain management
 - Contracture management
 - Reduce edema
 - Maximize pre-prosthetic mobility
 - Wheelchair mobility
- Prosthesis-phase
 - Maximize mobility
 - Gait training
 - Complication avoidance
 - Self-management
 - Strengthening

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General: Pressure zones

- Any bony prominence or exposed tendon



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General: Contractures

- Transtibial= knee flexion
- Transfemoral= FLABER
- Transradial= elbow flexion
- Transhumeral= FLABER
- Prosthesis use becomes impractical if contracture is greater than 25*.

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General: Outcome Measures

- AMPPRO/AMPnoPRO
- CHAMP
- Plus-M
- S.M.A.R.T.
- TUG
- 6 MWT

KD	AMPPro	AMPnoPro
K1	15-26	9-20
K2	27-36	21-28
K3	37-42	29-36
K4	43-47	37-43

Measure	Score	Interpretation
1. Mobility in the Right Arm	0-100	0-100 = Normal
2. Mobility in the Left Arm	0-100	0-100 = Normal
3. Mobility in the Right Leg	0-100	0-100 = Normal
4. Mobility in the Left Leg	0-100	0-100 = Normal
5. Balance	0-100	0-100 = Normal
6. TUG	0-100	0-100 = Normal
7. 6 MWT	0-100	0-100 = Normal

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General: Dressings

- Refer to general wound management and dressings in SB book.

- Soft
 - Elastic vs non-elastic
- Rigid
 - Rigid removable limb protectors
- Know s&s of infection



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Wraps

- Apply pressure > distally than proximally
- ½ overlap
- No concentric unless securing the wrap at top or bottom (not a tourniquet)
- 2 fingers underneath vertically
- No tape on skin
- Always go one joint proximal to level of amputation



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General: Phantom Limb

- Specific to persons with limb loss
- For UE: mirror box
- For LE: Mirror stand
- Other Rx's:
 - Desensitization protocol
 - TENS
 - Medical



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General: Complications

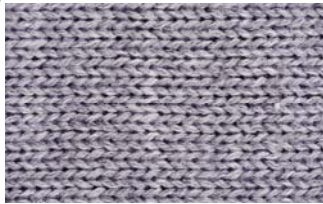
- Skin breakdown
- Fungal rashes
- Neuromas
- Heterotopic ossification



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General: Desensitization

- Conservative to "less" conservative
 - Silk → cotton → wool
 - 1 minute → 3 minutes → 5 minutes
 - Room temp water → cold water
 - Distal to sensitive areas → proximal



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General: WC Modifications

- Wheelchair adapters offset wheels
- For b/l TF they will use a WC at least partially
- Know accommodations for w/c (ADA)



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General: Self-Management

- Hygiene
- Fit of prosthesis
- Skin checking
- Wearing Schedule



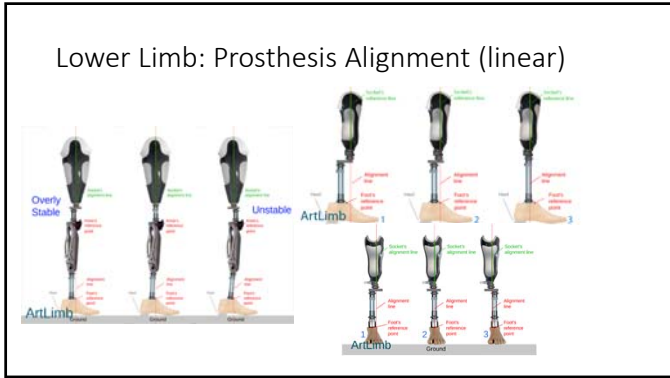
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Lower Limb: First Steps

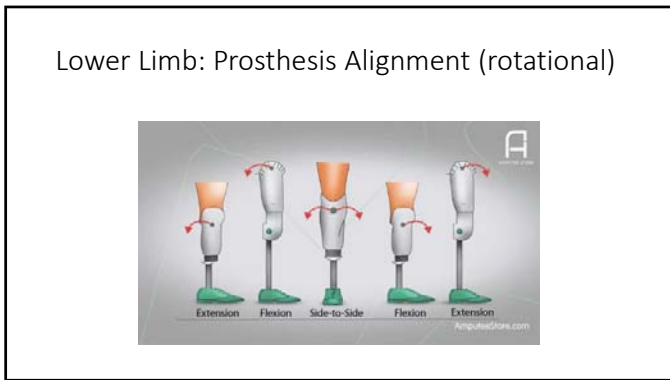
- Stand before walking
 - Feet apart
 - Feet together
 - Stride
- Weight shifts
 - All planes
- Initiate step with non-prosthetic limb
 - Allows for pelvic "whip" effect
- UE support decreased as appropriate



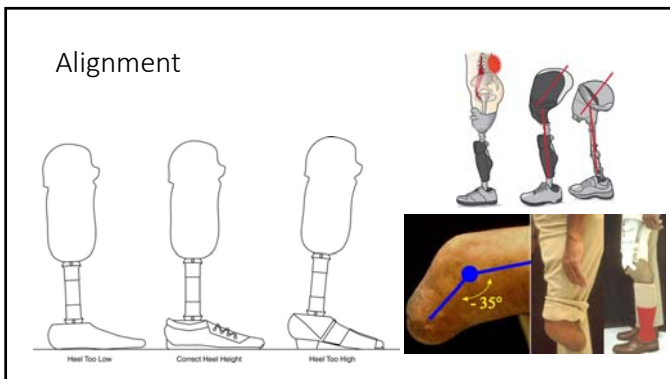
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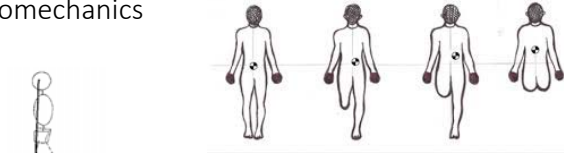


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Biomechanics



https://www.physio-pedia.com/Lower_Limb_Prosthetic_Introduction

<https://ouhsc.edu/bserdac/dthomps/web/gait/pobmk/frames.htm>

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Lower Limb: Gait deviations

<p>Stance</p> <ul style="list-style-type: none"> • ER of foot at IC • Knee instability TT/TF • Knee hyperstability TT • Lateral lean • Vaulting 	<p>Swing</p> <ul style="list-style-type: none"> • Whips • Circumduction TF • Unequal step lengths
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What Causes Deviations?

- Prosthesis
- Patients capability and general condition
- Shape, length and size of the residual limb
- Discomfort
- Inadequate or incorrect re-education
- Psychological, social or economic reasons

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Stance


- What you see: Foot rotation on prosthetic side @ IC
 - Usually laterally
- When: initial contact
- Where: prosthesis
- Why:
 - Hard heel cushion
 - PF bumper too firm
 - Poor socket fit/loss of suspension
 - May see this happen as the day goes on
 - Weak hip musculature
 - Unable to control
- How:
 - Call prosthetist if related to prosthesis
 - Poor fit/suspension = problem solve
 - Strengthen hip



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Stance


- What: knee instability
- When: IC → Loading response
- Where: TT prosthesis
- Why:
 - Socket overflexion
 - Foot set into too much DF
 - Hard heel
 - Quad weakness
- How:
 - Call prosthetist
 - Strengthen quads



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Stance

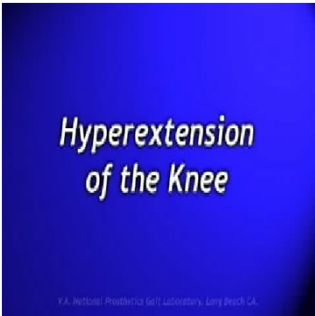
- What: knee instability
- When: IC → LR
- Where: TF prosthesis
- Why:
 - Hip weakness
 - Insufficient socket flexion
 - Socket positioned posteriorly to the knee
- How:
 - Train concentric hip extension during heel
 - Call prosthetist



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Stance

- What: Knee hyperextension
- When: IC → LR
- Where: TT Prosthesis (mostly seen in TT)
- Why:
 - Foot set in PF
 - Soft heel
 - Posterior socket offset
 - Also known as long toe lever
 - Weak quads(!?)
 - Lacks confidence
- How:
 - Call prosthetist
 - Strengthen quad
 - Increase confidence



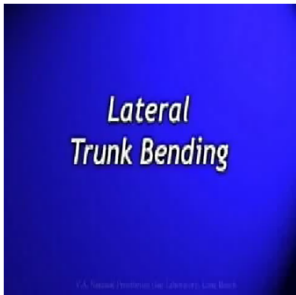
Hyperextension of the Knee

P.A. Johnson Prosthetic Bell Laboratories, Long Beach, CA

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Stance

- What: lateral lean
- When: midstance
- Where: prosthetic limb
- Why:
 - weak hip ABD
 - Leg length discrepancy
 - Likely short on prosthesis
 - Too deep into the socket
- How:
 - Strengthen
 - Specifically with CKC
 - LLD correction
 - Either shoe lift or prosthetist adjust pylon height
 - Add sock ply




Lateral Trunk Bending

P.A. Johnson Prosthetic Bell Laboratories, Long Beach, CA

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Stance


- What: Vaulting
- When: midstance
- Where: sound limb
- Why:
 - Prosthesis too long
 - Prosthesis not suspended properly
 - Prosthesis not being loaded correctly
- How:
 - Adjust prosthesis
 - Pelvic initiation



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Swing

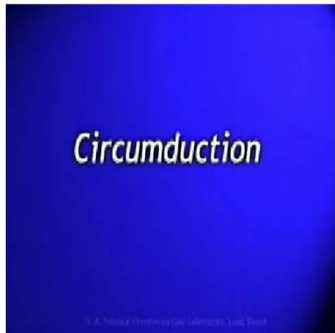
- What: medial/lateral whip
- When: initial swing
- Where: TF (mostly) prosthesis
- Why:
 - Mal-aligned prosthesis
 - Loose fit
 - Donned improperly
 - Loss of suspension
- How:
 - Self-management skills



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Swing


- What: Circumduction
- When: Swing
- Where: TF prosthetics
- Why:
 - Prosthesis long
 - Hip Abd contracture
 - Improper suspension
 - Fail to initiate knee flexion (TF)
 - Afraid to flex knee
 - Short contralateral step
- How:
 - Call prosthetist
 - Stretch into add
 - Self-management education
 - Educate patient on 70% rule
 - Work on weight acceptance
 - Gait training



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Swing

- What: Long step / short step
- When: terminal swing → IC
- Where: prosthetic limb/ sound limb
- Why:
 - Fear
 - Pain
 - Decreased weight acceptance
 - Dec balance on prosthesis
- How:
 - Weight acceptance progression
 - Pain management



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Credit is due to...

<http://www.oandplibrary.org/alp/chap14-01.asp>



Dcraig35 @ youtube

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Osseointegration



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Rotationplasty



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Red flag 1

- DO NOT FALL OR INJURE THE RESIDUAL LIMB!

 A person with a prosthetic leg is sitting on a white surface. They are wearing a black brace over their residual limb and the prosthetic leg.

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Red flag 2

 Two side-by-side photographs of a prosthetic limb stump. The left image shows the stump before a dressing, and the right image shows it with a dressing.

Figure 1. Postoperative BKA stump before NPWT/ROCF dressing. Figure 2. BKA stump with NPWT/ROCF dressing.

- Facilitate wound closure
 - Perform daily inspections on inpatient if capable
 - Educate patient/family on how to perform if outpatient
 - Protect the wound (rigid removable limb protector)
- Red Flag #2: The longer the wound is open, the longer it takes to be fit, the less likely they will be successful with the prosthesis

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Red flag 3

- Failure to shape early can lead to deformity and complications wearing a socket. However...do not "force" it.



- Red Flag #3: Dog ears, prominent bony prominences, bulbous ends can result in inability to tolerate pressure in the socket, requiring numerous socket reliefs and time away from functional mobility.

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Red flag 4

- Pre-prosthetic mobility
 - Focus on what they NEED to do...not what some arbitrary goal states
 - Transfers
 - Bed mobility
 - Ambulation
 - Stair negotiation
 - Wheelchair

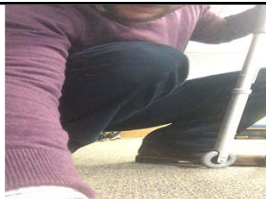


- Red Flag #4: The longer one is in a rehabilitation facility, the higher the risk of nosocomial infections. Better to go home safe pre-prosthetically than stay inpatient longer than needed

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Red flag 5

- Do you hear that?
- Golden rule #5: Eccentric control is key!



- Red Flag #5 If you hear that noise, and your patient is a dysvascular amputee, they are endangering themselves with every hop.

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Red flag 6

- Wear into the prosthesis gradually. It builds problem solving and donning/doffing skills while preventing secondary complications.



- Red flag #6: Developing preventable secondary complications from not adhering to wear schedule will delay prosthesis adoption or result in major medical issues.

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Red Flag 7

- Consistency of limb shape is the key for a proper fit.



- Red Flag #7: If massive fluctuations in fit occur day to day, it could be dietary or medicinal interaction. Have patient keep a diary to assess for changes in either.

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Red Flag 8

- Donning is a massive stumbling block for most new users. Be cautious not to eschew your responsibility in this part of training, but also do not forgo functional mobility in place of.



- Red Flag #8: work with OT to prioritize donning techniques/problem solving if possible. Provide user with customized written picture guide early on to prevent unnecessary time being lost in session.

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Red Flag 9

- Based on the prosthetic componentry, reciprocal gait may not be possible...so do not always chase it!



- Red Flag #9: Forcing reciprocal gait patterns prematurely or on componentry that cannot facilitate the motion may lead to discouragement and burnout.

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Upper Extremity

Likely

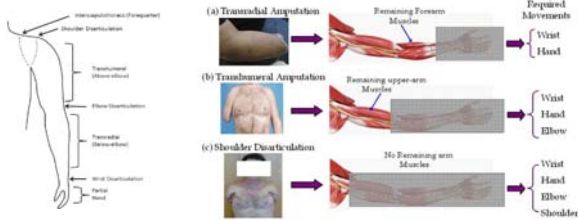
- 1 question MAX
- ROM needed
- Strength needed
- Understanding level of amputation

Unlikely

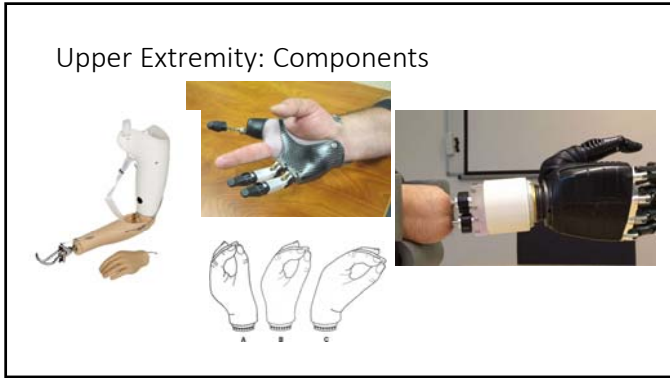
- >1 question
- Anything to do with adjustments
- Anything to do with a specific suspension
- Anything to do with a specific component

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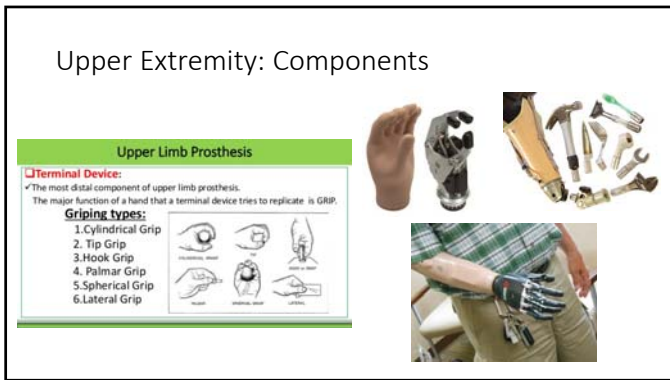
Upper Extremity



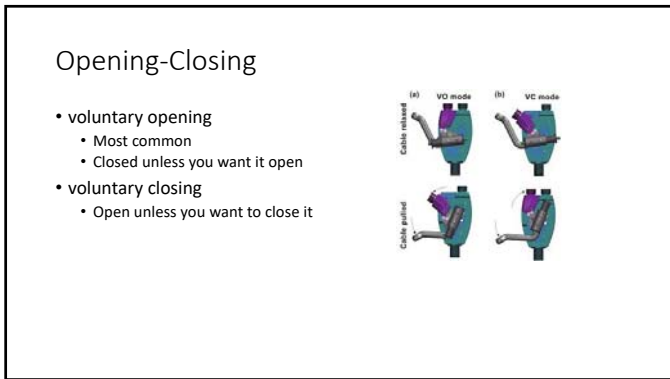
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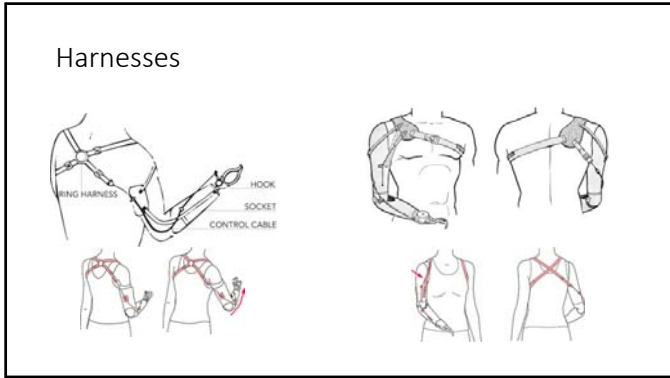
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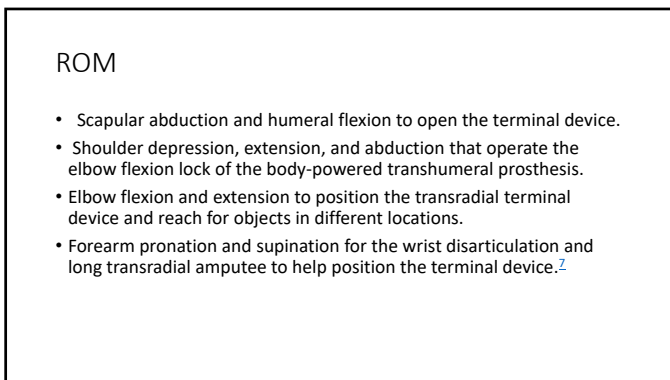
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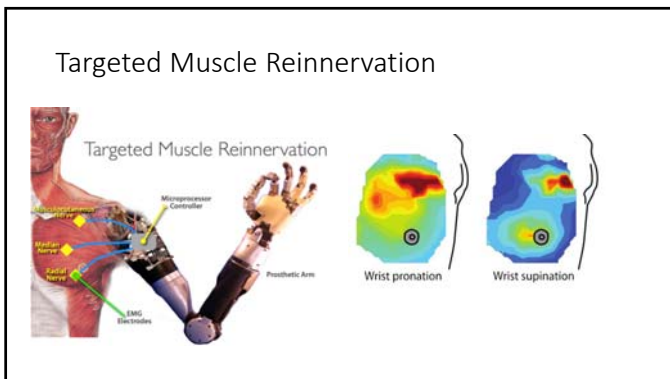
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General: When in Doubt...

- Go conservative...
 - "Less is more."
- If outside of scope of practice...refer out!
- Leave it off!
- Don't touch the screws!

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More Information

- Easiest to Digest
 - Scorebuilders
 - Has everything you need to know
 - Lacks depth of a focally dedicated textbook
 - Limb loss in Older Adults: Comprehensive Care Across the Spectrum of Clinical Settings
 - Not on the NPTE
 - Basically a full version of this presentation.
- Mostly Digestable
 - Prosthetics & Orthotics in Clinical Practice
 - Great for clinical practice
 - Covers everything you need to know to be a good practitioner
 - Over 5 years old...
 - Orthotics and Prosthetics in Rehabilitation, 4th Edition
 - Printed in 2020...



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Need more info?

- Email: Daniel.lee29@touro.edu

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Questions?



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Feedback? Let Us Know!



We would love to get your general feedback on today's session and ideas for subject matter for future Spotlight Sessions!



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SPOTLIGHT
Series

Good Luck and Thanks for Tuning In!

Visit our website www.scorebuilders.com for more information on our entire PT and PTA product line.



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