MICROPROCESSOR KNEE UPDATE – PART II

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GAIT TRAINING WITH MPKS

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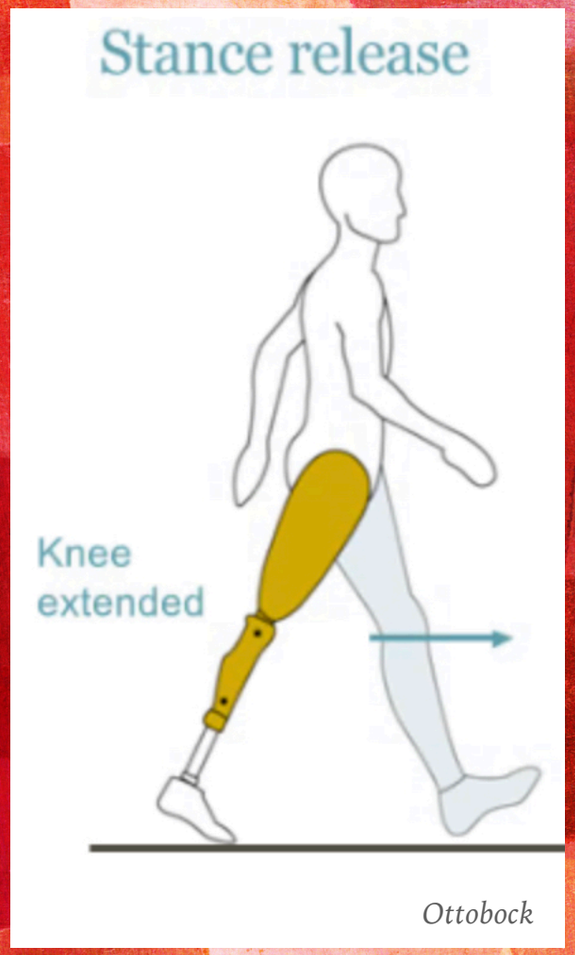
A journey of a thousand miles begins with a single step.

-Lao Tzu



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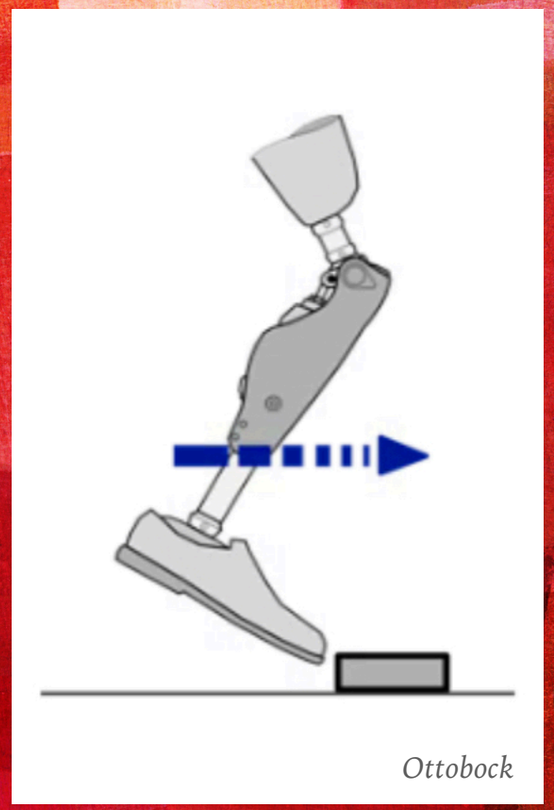
INITIATING SWING

- Goal: initial 30 deg knee flexion at toe off
- Key Criteria
  - Knee extension moment
  - Adequate toe load (Plié, Orion, older C-leg)
  - Forward rotational movement and inclination of the shank (newer C-leg, Genium/X3)
  - Also, ground reaction force near the middle of the foot and 60% of body weight through the prosthesis (Genium/X3)



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STUMBLE RECOVERY

- Increase safety and aid in fall prevention
- How it works:
  - When swing is interrupted, flexion resistance ramps up higher than adjusted setting
  - Provides enhanced stability for landing on the prosthetic side
  - Allows for more time to shift weight to contralateral side

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STANCE FLEXION

- 10-15 deg of knee flexion during loading response
- Full extension during midstance through preswing
- Benefits
  - Improved shock absorption
  - Reduced subsequent orthopedic problems
  - Easier, safer negoti
  - Reduction of compensatory movements

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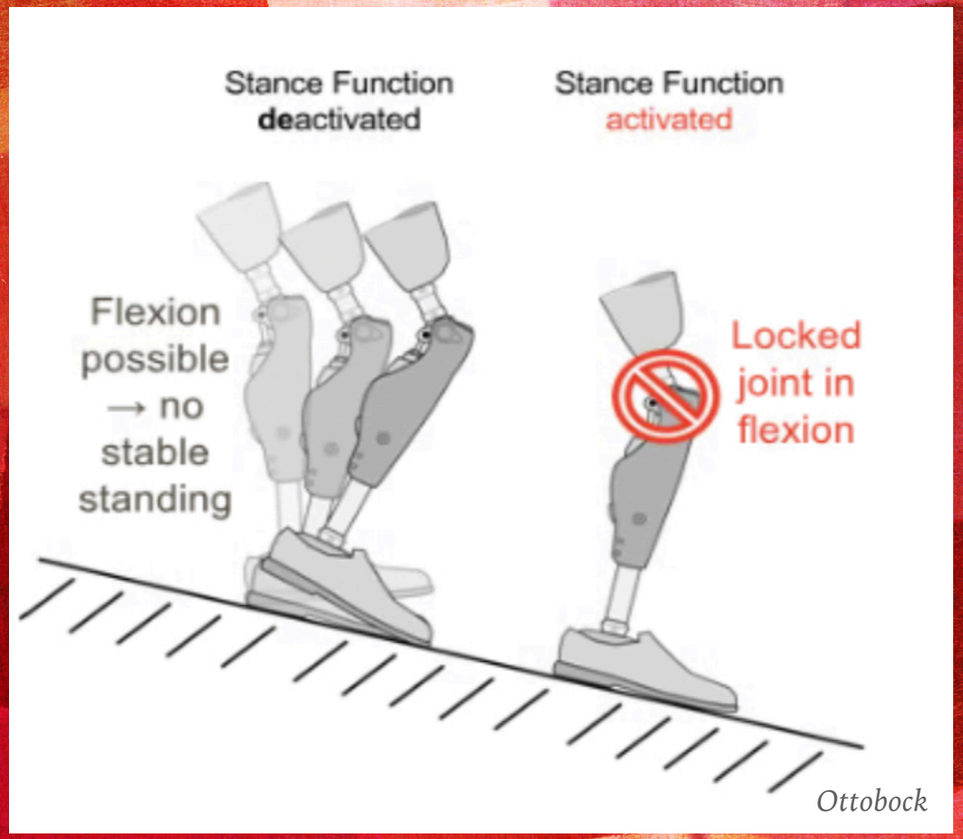
STAIRS

- Stance yielding on stairs for step-over-step descent
- Key criteria
  - Foot placement (halfway off of the step)
  - Maintain body weight over the knee
  - Muscle pull against posterior wall of socket (control descent)
  - Ride the knee down



INTUITIVE STANCE

- Option with the C-leg, Genium/X3, Orion
- Key Criteria
  - Standing still with weight through the prosthesis and the knee bent
  - Knee will block further flexion
  - Release by lifting up or fully extending the knee

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OBSTACLE CLEARANCE

- Specifically for the Genium/X3
- Key Criteria
  - Specific movement pattern is needed to trigger this function
  - Keep weight on the prosthesis
  - Extend the hip to bring the leg backwards, while maintaining slight contact with the floor
  - Then quickly flex the hip and bring the leg forward and up

OTHER MODES

- MPKs with alternate modes
  - C-leg
  - Genium/X3
  - Rheo XC
  - Orion
- Mode options
  - Biking (free swing)
  - Locked standing (in extension or flexion)
  - Increased resistance in a limited range
- Switching between modes

TROUBLESHOOTING MPKS

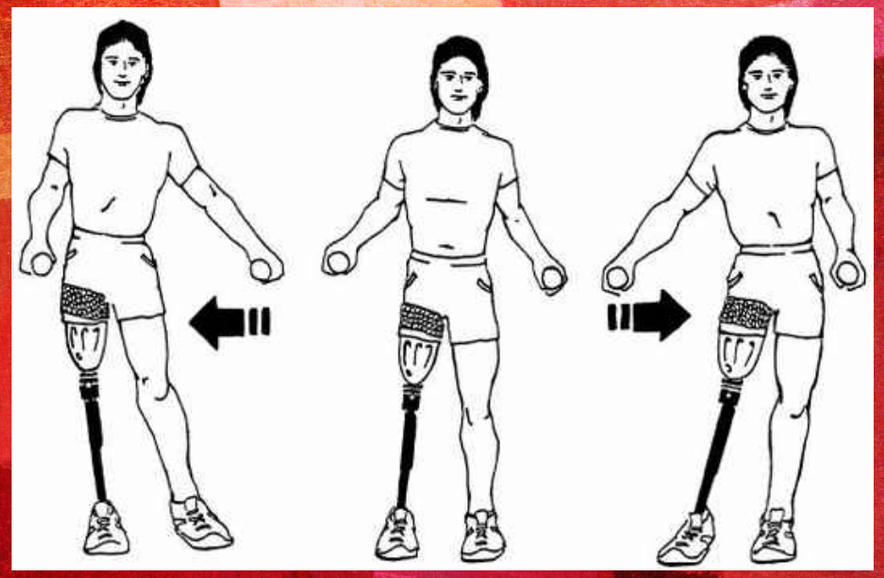
“

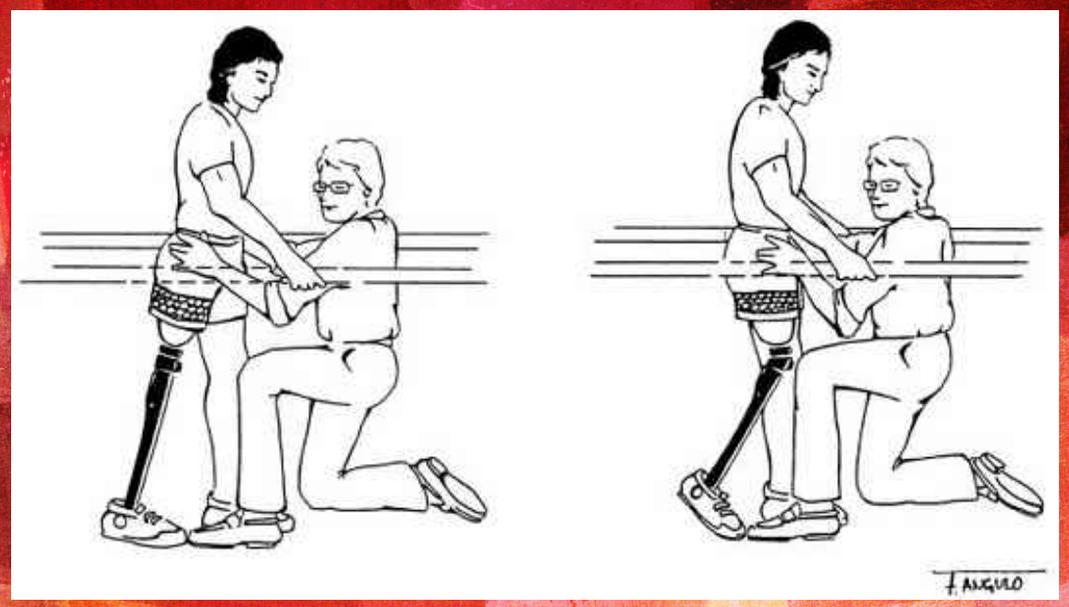
Every problem is a gift. Without them, we wouldn’t grow.

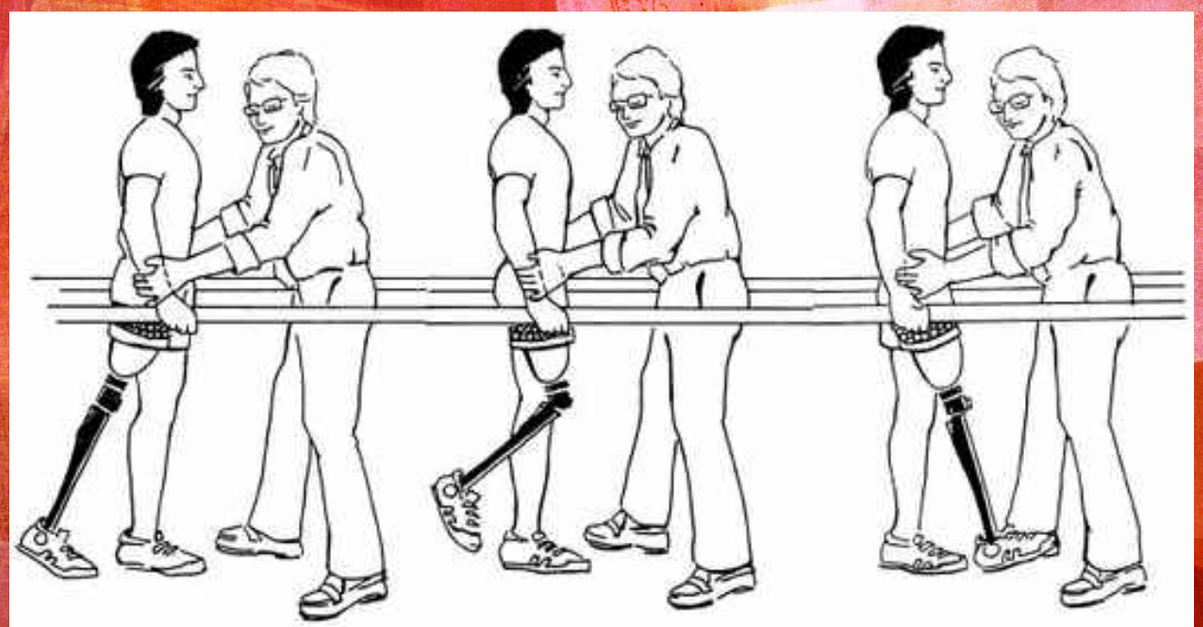
-Tony Robbins

TROUBLESHOOTING HELP

- ***Problem: Knee does not release into swing.***
- Patient Causes:
  - Inadequate toe load
  - Knee does not get to full extension pre-swing
  - Hip hiking/circumduction
- Prosthetic Causes:
  - Release threshold set too high



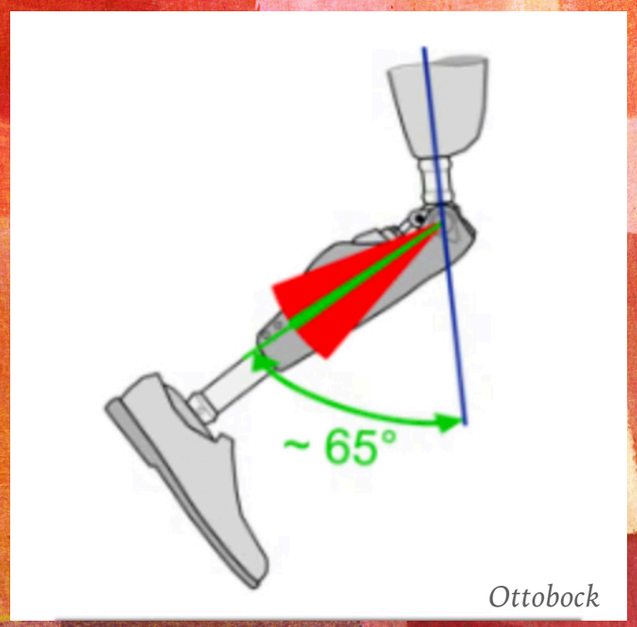




TROUBLESHOOTING HELP

- ***Problem: Knee does not release into swing.***
- Solutions:
  - Focus on keeping weight on the prosthesis and generating hip power
  - Weight shifting practice
  - Hip power: pelvis transverse rotation
  - Prosthetic limb stepping forwards and backwards in parallel bars
    - Rhythmic initiation then full steps
  - Resisted walking (with bands)
  - Baby steps

Illustrations by Frank Angulo/Robert Gailey



TROUBLESHOOTING HELP

- ***Problem: Toe is scuffing the floor during swing.***
- Patient Causes:
  - Not generating adequate knee flexion for swing
- Prosthetic Causes:
  - Prosthesis is effectively too tall
  - Knee is not fully releasing into swing
  - Heel rise is too shallow

Amputee Walking School: Todd & Dennis

TROUBLESHOOTING HELP

- ***Problem: Toe is scuffing the floor during swing.***
- Solutions:
  - Check sock-ply and overall height. Is the pelvis level? If not, are they too high up out of the socket? Try reducing sock-ply.
  - Check knee flexion. Goal is 30 deg knee flexion at toe off, 60-65 deg knee flexion during initial swing.
  - Leg swings, focusing on the pull backward

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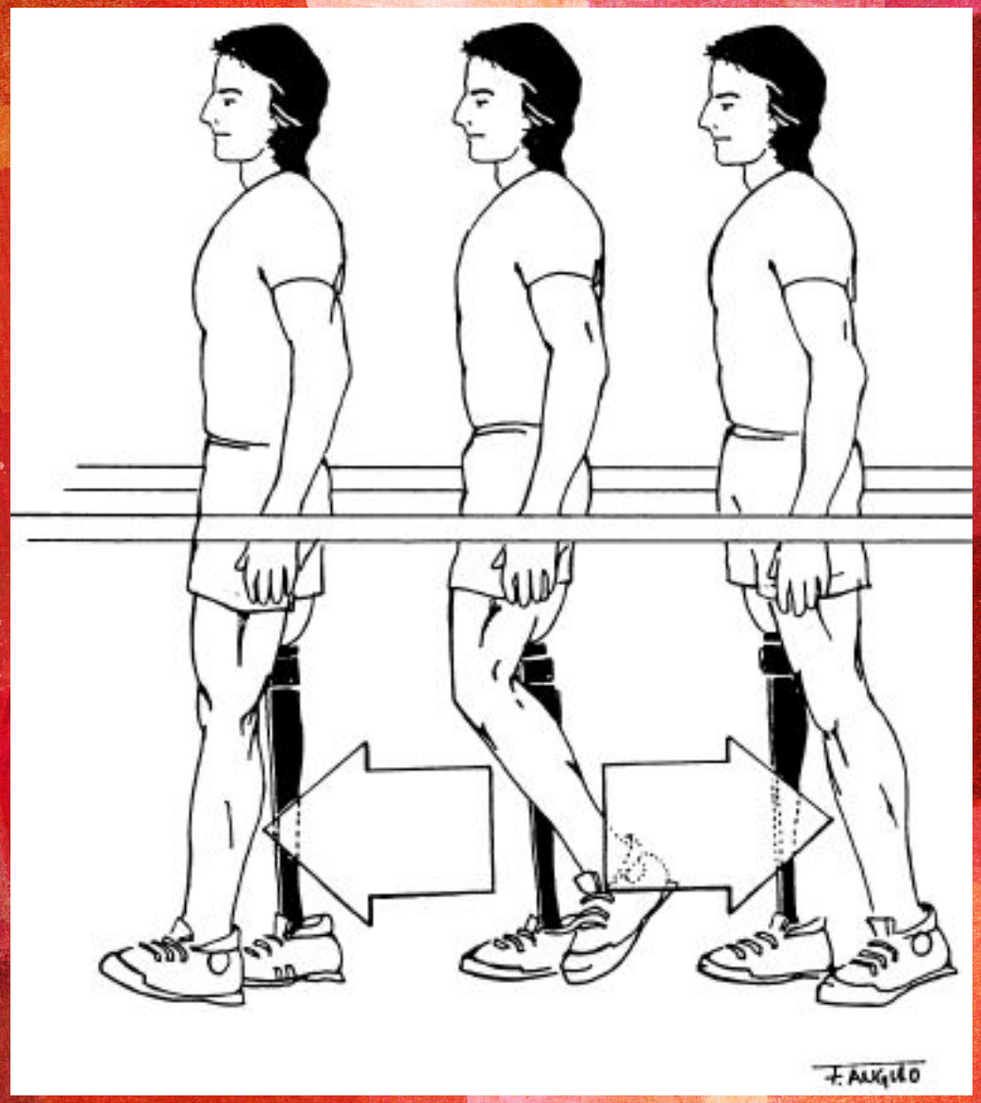
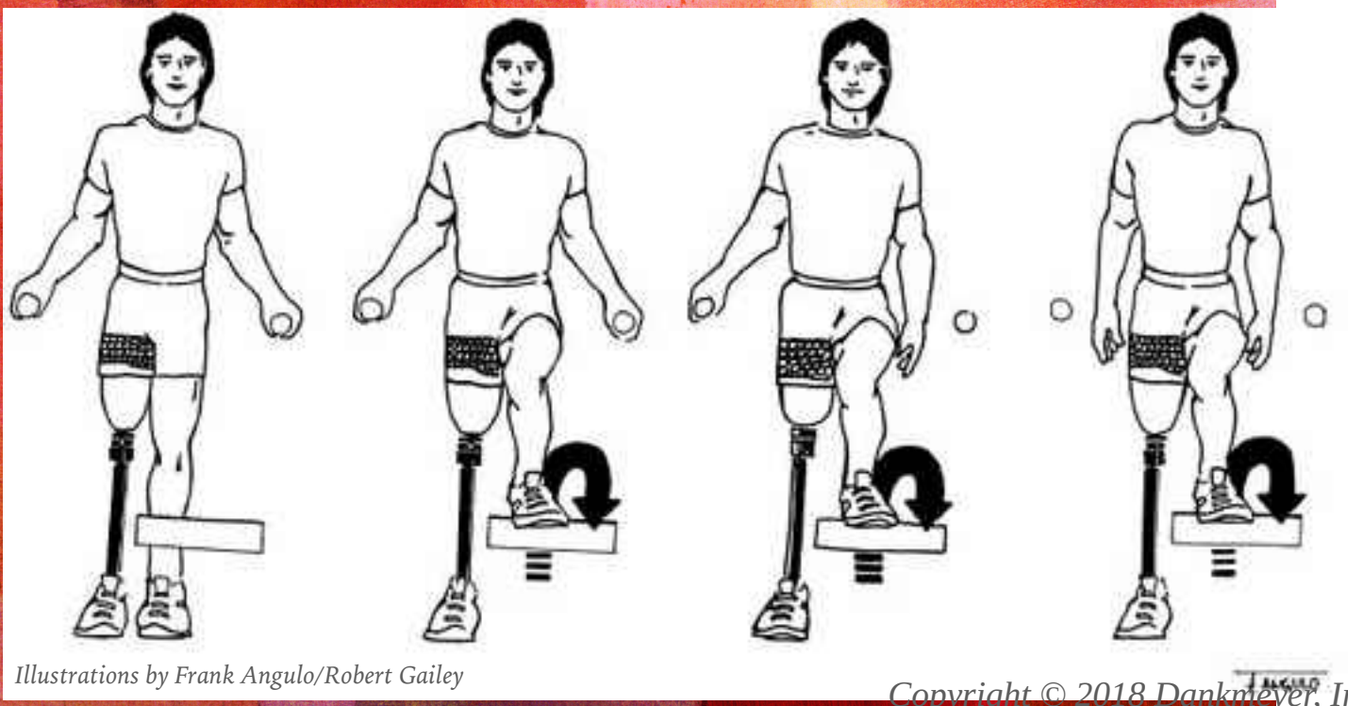
TROUBLESHOOTING HELP

- ***Problem: Uneven step length during gait.***
- Patient causes:
  - Does not fully weight shift or trust the prosthesis during stance
  - Takes too long of a step with the prosthesis
- Prosthetic causes:
  - Prosthesis is too short or too tall





Illustrations by Frank Angulo/Robert Gailey

TROUBLESHOOTING HELP

- ***Problem: Uneven step length during gait.***
- Solutions:
  - Focus on single limb stance on the prosthetic side
  - Weight shifting fully to the prosthesis
  - Sound limb stepping forwards and backwards in parallel bars
  - Parallel bar step tap-ups (slow and controlled)
  - Shorten steps with the prosthesis

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TROUBLESHOOTING HELP

- ***Problem: No stance flexion during loading response.***
- Patient causes:
  - Does not know how to initiate stance flexion
  - Does not trust knee flexion in stance
- Prosthetic causes:
  - Non-optimal alignment for stance flexion

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TROUBLESHOOTING HELP

- ***Problem: No stance flexion during loading response.***
- Solutions:
  - Weight shift diagonal from sound limb to prosthesis
  - Single limb squats

VA Gait Deviations Video

TROUBLESHOOTING HELP

- ***Problem: Knee buckling/ excessive flexion during stance.***
- Patient causes:
  - Weak or ineffective use of glutes to pull back on socket
- Prosthetic causes:
  - Knee alignment set too unstable

Amputee Walking School: Todd & Dennis

Amputee Walking School: Todd & Dennis

TROUBLESHOOTING HELP

- ***Problem: Knee buckling/excessive flexion during stance.***
- Solutions:
  - Focus on glutes pulling back on the socket
  - Resisted heel strikes
  - Forward shifting of weight
    - Try to lift up their prosthesis or make the knee bend
  - Baby steps
  - Grid work/target strikes

REFERRING BACK TO THE PROSTHETIST

“

A team is not a group of people who work together. A team is a group of people who trust each other.

-Simon Sinek

FUNCTIONAL CHANGES

- Change in assistive device
- Change in self-selected walking speed
- New activities

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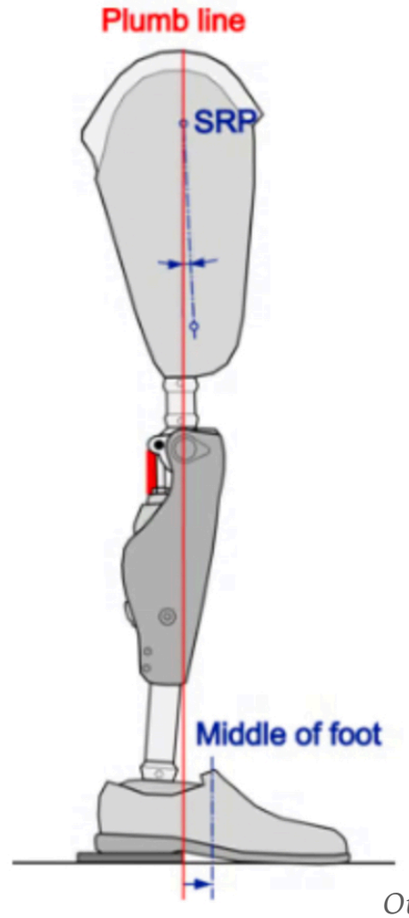
- What the prosthetist can do:
  - Review/reprogram MPK settings to optimize for their new gait pattern.

ALIGNMENT CONCERNS

- Change in hip range of motion/contracture
- Shoe change (different heel height)
- Prosthetic is leaning (forward/backward, medially/laterally) during standing and gait



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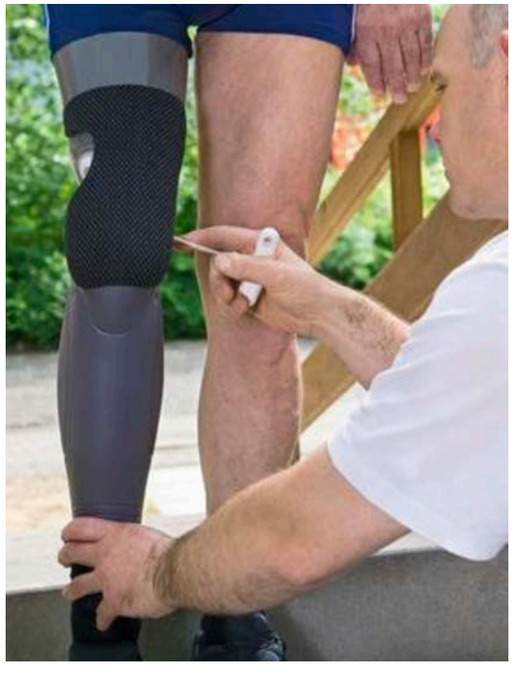
- What the prosthetist can do:
  - Manually adjust the alignment to match their current condition
  - Note, this may need to be readjusted if they change back

UNRESOLVED GAIT ISSUES

- Gait training was not able to resolve certain issues(unable to initiate swing, catching foot, etc.)
- Further troubleshooting is needed

- What the prosthetist can do:
  - Fine tune MPK settings
  - Adjust prosthetic height or alignment



MALFUNCTIONING KNEE

- Knee is beeping, buzzing
- Knee buckles or gives out when it shouldn’t or remains stiff
- Knee is not charging properly

- What the prosthetist can do:
  - Most MPKs are not field serviceable
  - The prosthetist can order a loaner knee to swap out and send the malfunctioning knee back to the manufacturer for evaluation
  - Depending on the location and the issue, this can take weeks to months to return

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  - Todd & Dennis: https://m.youtube.com/watch?v=Uh6sesBZ00A