Essential Physiotherapy – The influence of posture and movement control in prosthetic use

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Presentation objectives
• To assess posture
• To learn about movement control
• How impacts on alignment, components & user experience
• Useful training techniques

Why this presentation?
• Normal posture & movement control changes after amputation
• Mobility difficulties with a prosthesis caused by incorrect prosthetic alignment, resulting in further poor movement control

Posture and prosthesis
Interlinked:
• Posture affects prosthetic alignment
• Prosthetic alignment affects posture
• Secondary conditions

The Clinical Question
• When should a lower limb prosthesis accommodate poor posture?
• When should a lower limb prosthesis correct a poor posture?
• When does a lower limb prosthesis cause a poor posture?
The User’s Problem

• The new limb wearer does not know what to expect from a prosthesis
• The new limb wearer does not know about body posture and alignment

Result - Unlikely to stand straight at fitting
• The established limb wearer may have ‘forgotten’ where is midline
• Permanent posture change or bad habit?

The Prosthetist’s Problem

• Bench alignment is starting point
• Align from foot upwards, not pelvis down
• Prosthetic design based on user having ‘normal’ posture and movement
• Static alignment v dynamic alignment
• Consider how is the prosthesis influencing the user’s posture and movement?

The Physiotherapist’s Problem

+ve impact
• Exercises create change but that impacts on alignment & component function

-ve impact
• Not always there!
• Lack of knowledge in prosthetics and how amputees move
• Not reaching optimal outcome for the user

Normal posture v amputee posture

Normal posture – side view
• Mid ear
• Shoulder
• Pelvic tilt
• Greater trochanter
• Behind patella
• In front of ankle
• Weight distribution over foot – check
• Use a plumb line

Normal posture – AP view
• Level eyes
• Level shoulders
• Level pelvis (iliac crests, ASIS, PSIS)
• Body creases
• Knee symmetry
• Equal weight bearing
• Look at spine
• Use a plumb line
• Compare in sitting
Also normal postural changes!

Posture changes in amputees

Without a prosthesis:
• Shift centre of gravity
• Small base of support
• External rotation L
• Hyperextended knee L
• Retraction & elevation R pelvic girdle
• Depression R shoulder girdle

Creep Phenomenon
• Change in inclination PSIS to ASIS
• Short hip flexors and back extensors
• Long weak abdominals, hamstrings & gluteals


‘Postural asymmetries in transfemoral amputees’ (2011)
• Leg length discrepancies (88%)
• Pelvic inclination
• Innominat asymmetry
• Increased lordosis
• Limited lateral trunk flexion
• Limited hip extension

Assess posture in sitting

Normal movement v amputee movement
Normal pelvic excursion – 5 cm vertical and lateral

Normal pelvic rotation – coronal and longitudinal 5°

Equal weight bearing & upright midline posture

Effect of pain on movement

• Pain inhibits or prevents muscle recruitment
• Short prosthesis & back pain, socket discomfort

Sensory feedback loop

Effect of ageing on movement

• Weak antigravity muscles
• Less elasticity in soft tissues
• Reduced range of motion
• Exaggerated posture
• Reduced balance reactions
• Slower cadence
Different muscle roles

**Mobilisers**

**Stabilisers**

Altered muscle patterns in amputees – lost control

- Femur into flexion at hip (stance) = unequal strides
- Lumbar spine into extension (stance) = excessive lordosis
- Femur into abduction at hip (stance) = lateral trunk bend
- Pelvis into retraction (swing & stance) = uneven timing
- Femur into medial rotation at hip (stance) = medial thrust

**Hip into flexion**

Causes:
- Hip fixed in flexion
- Weak hip extensors – poor power, slow or poor timing
- Weak abdominals
- NB: Cannot get upright posture if do not accommodate with more flexion in the socket
- NB: This will affect knee stability if socket not repositioned.

**Lumbar spine into extension**

Causes:
- Hip in flexion
- Weak abdominals, hamstrings and hip extensors
- Tight back extensors & hip flexors
- Associated back pain
- Check socket flexion, length & knee stability

**Hip into abduction**

Causes:
- Fixed in abduction
- Weak abductors - poor power, slow or poor timing
- Unstable femur in socket
- Lateral trunk bend to prosthetic side in stance
- Check leg length and prosthetic knee stability

**Pelvis into retraction, swing and stance**

Causes:
- Innominate asymmetry
- Weak extensors and abdominals
- Tight hip flexors
- NB: Must stabilise knee if correcting posture alignment
- Check length
Internal rotation of femur (TT)

**Cause:**
- Poor hip stability
- Results in reduced quadriceps power and control
- VMO inhibition
- Increases feelings of instability
- Check socket stability & foot position

**Result - secondary conditions**

**Altered biomechanics:**
- Osteoarthritis – pain & inflammation (sound side hip & knee)
- Osteoporosis – risk of fractures (30% less bone density amp hip)
- Back pain – 50-60% moderate to severe (Gailey et al 2008 & 2011)

**Better understanding leads to better outcomes**

**How does this relate to the prosthesis?**

Examples of changes with altered alignment

**The Clinical Question**

Prosthetic alignment:
- Accommodate?
- Correct?
- Cause?
Transfemoral alignment

Bilateral TF alignment

Poor alignment bilateral

Better alignment bilateral

Applying the Thomas test!

Assess in standing
In summary:
- Know about changes to posture, to muscle recruitment, movement patterns & body control after amputation
- Prosthesis can accommodate or correct (facilitate more normal posture and muscle use)
- Bad habits (compensations) for a good reason – correct or manage?
- Poor posture & alignment results in poor prosthetic control and secondary conditions

What does all this mean for the prosthetic user?
The end game...

Incorrect alignment & posture:
Mobility difficulties:
- Excess socket forces
- Joint & soft tissue pain
- Component dysfunction
- Fatigue & abnormal muscle patterns
- Reliance on walking aids
- Falls & lack of function
- Lack of confidence
- Avoidance & reduced quality of life

What must we do?
- Correct & control their posture at fitting stage
- Teach correct weight bearing and muscle recruitment
- Adjust prosthetic alignment & length accordingly
- On-going issue needs regular reviews and re-training

Fitting room physio...
Essential training techniques

‘See and feel’ a good posture
Check equal weight bearing

- Place a piece of paper under prosthetic foot
- Ask the patient to weight bear equally on both lower limbs
- Ask them not to let you pull the piece of paper out from under their prosthetic foot

Check leg length

- Kneel down - pelvis at eye level
- Ensure equal weight bearing
- Fingers on top of iliac crests
- Thumbs on ASIS & PSIS

Five essential exercises for movement control

- “Feel the foot” and sway
- Step on box
- Tennis ball stability
- Walk a tightrope
- Pelvic progression TF level OR soft knee loading for TT level

“Feel the Foot”
- Sensory awareness of heel, big toe and 5th toe (loop)

Sway – weight transfer over foot

Weight transfer over the foot

- Lateral Shift
- Anterior-Posterior Shift
Stepping on box

- Start with prosthetic foot near to block
- Use the bars
- Step up on to the block with the sound limb
- Encourage weight transfer laterally over the prosthetic limb
- Pelvis not to tilt AP

Stepping on a box

- Bars for light support / balance only
- Keep shoulders level
- The body should not bend down to the side of the prosthetic limb
- Keep the body upright
- Make sure the hip is forwards and straight

Stepping on a box

Tennis ball for dynamic stability

- Walk along a tape or an imaginary line
- // bars then independently
- Ultimate test of weight transference and hip control

Tightrope walking

Forward pelvic progression in swing
Forward pelvic progression in stance

Soft knee loading – stance flexion

10-15 degrees of knee flexion at initial contact to foot flat
Train sound and prosthetic sides

Long term collaboration

Teach your prosthetist these basics!
Fitting stage

Thank you

Laura:
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