Pre prosthetic exercises for the lower activity transfemoral amputee

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Your presenter

- Pace Rehabilitation
- Manchester, UK
- Private independent clinic
- Trauma amputees mainly
- Some lower activity due to other injuries, low confidence, poor fitness
- 24 years experience

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Older amputee experience:
- 15 years NHS
- Vascular surgery unit
- Regional Limb Centre
- Prosthetic rehab:
  - inpatient, outpatient & community settings
Presentation objectives

- Theory behind pre-prosthetic exercises
- Knowledge to develop an effective programme
- Improved assessment skills
- Effective results
Who are we talking about?

A typical UK patient with amputation:
- 80% over 65 years age
- Predominant cause vascular and diabetic disease
- Multiple pathology
- Fewer demands from prosthesis
- Well served by NHS teams

SIGAM grade C
- limited/restricted; walk up to 50m, on even ground, with or without walking aids
- a = frame, b = crutches/sticks, c = 1 crutch/stick, d = no aids

K2
- limited mobility; ability or potential to use a prosthesis for ambulation, ability to adjust to low level environmental barriers (curbs, stairs, uneven surfaces).
- Limited periods of walking, without significant varying speed
Considerations for successful rehabilitation programmes

- Elderly - Ageing process
- Co-morbidities
- Sedate lifestyle pre amputation
- De-conditioned
- Established posture and movement habits, changed gait patterns
- High risk of falls
- Cognition – how can you test?
- Prosthesis – how do you choose?
Useful objective prosthetic assessment tools

- Amputee Mobility Predictor
- Transfemoral Fitting Predictor
- Kendrick Object Learning Test
AMPnoPRO

The Amputee Mobility Predictor: an instrument to assess determinants of the lower-limb amputee ability to ambulate.


Physio Tools
The trans-femoral fitting predictor: a functional measure to predict prosthetic fitting in transfemoral amputees—validity and reliability.

Kendrick Object Learning Test (KOLT)

Do psychological measures predict the ability of lower limb amputees to learn to use a prosthesis?

(Larner, Van Ross, Hale Clin Rehabil, 2003; 17: 493 -498)
Background knowledge & accurate assessment

What should we be thinking about?
Goal – minimise prosthetic gait deviations

- Lateral trunk bend
- Abduction
- Circumduction
- Vaulting
- Lack of trunk rotation
- Excess lumbar lordosis
- Uneven step, timing and arm swing
- Poor knee control
Normal posture – side view

- Mid ear
- Shoulder
- Pelvic tilt
- Spinal curves
- Greater trochanter
- Behind patella
- In front of ankle
- Equal weight distribution over foot
Normal posture – AP view

- Level eyes
- Level shoulders
- Level pelvis (iliac crests, ASIS, PSIS)
- Body creases
- Knee symmetry
- Equal weight bearing
- Spinal curves
- Tip - Use a plumb line & compare in sitting
Normal postural changes!

1. Bony misalignments force the arches to lower, shifting the centre of gravity inward and forward. This generates imbalances throughout the entire musculoskeletal structure.

2. Hyper-extended knees

3. Whole body leans forward

4. Pelvis tilted forwards, causing buttocks to protrude

5. Protruding abdomen

6. Increased curvature of lower spine

7. Sagging chest and rounded shoulders

8. Increased curvature of upper spine

9. Jaw drops

10. Increased curvature of neck

11. Head tilted forward and downward
Normal posture changes in the amputees over time

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

- Prolonged postures changes tissue length
- 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
- Innominate asymmetry
- Increased lordosis
- Limited lateral trunk flexion
- Limited hip extension

Gaunaurd I, Gailey R, Hafner B, Gomez-Marin O & Kirk-Sanchez N
Pros & Orthot Int 35 (2) 171-180
Normal ageing process

- Weak antigravity muscles
- Less elasticity in soft tissues
- Reduced range of motion
- Exaggerated posture
- Reduced balance reactions
- Slower cadence
Energy expenditure in amputees

- Unilateral TTA: 9% more required
- Unilateral TFA: 49% more
- Bilateral TFA: 280% more (reference?)
- Individuals with traumatic amputation demonstrate a more energy efficient gait than those resulting from vascular or neuropathic disease
Ageing and exercise

Exercise programmes offset age related disabilities.
(Bennet KJ, 2000, Geriatr Aging 3;12)
Diabetes and exercise

- Exercise lowers blood sugar
- Rehabilitation (PT & OT)
- TF casting (stand)
- Prosthetic fitting
- Monitor
- Be prepared!
Effect of pain on movement

Pain inhibits or prevents muscle recruitment


Why is gait pattern really that important in the lower activity amputee?
High falls risk population!

- Significant absence of sensory feedback
- Changes in body weight distribution
- Postural instability & muscle imbalances
- Negative influence, external force of prosthesis
- Higher level and multiple amputations
- An aged population suggests 4+ co-morbidities, cognition, 2+ medications
- Vulnerability, liability and opportunity
Falls management

- **Cochrane Review 2006**
  Specialist MDT, multi-factorial assessments including health screening, individually tailored home exercises

- **OTAGO exercise programmes**
  Strength, balance, flexibility and walking
  (John Campbell, Prof in Geriatric Medicine & M Clare Robertson, Senior Research Fellow, University of Otago Medical School, New Zealand)

- **Stumble recovery** – work the extensors

- **NICE Guidelines (Nov 2004)**
  Multi-factorial risk assessment
  ‘Falls: the assessment and prevention of falls in older people’  (www.nice.org.uk/CG21NICEguideline)
Targeted exercise programme

- Tailored to individual needs
- Use *combined muscle actions* which relate to normal gait
- Facilitate normal movement of residual limb
- Discourage neglect
- Improve muscle strength, recruitment & co-ordination
- Promote weight transference
- Re-educate proprioception
- Facilitate static and dynamic balance reactions
- Increase cardiovascular fitness & exercise tolerance
Different muscle roles – altered recruitment in amputees

Mobilisers - move

Stabilisers - control
Postural Awareness

- Find neutral position
- Normal tissue length
- Postural stabilisers create stable base
- Improve muscle recruitment & movement control
Finding neutral, greater support

- Excessive posterior tilt
- Excessive anterior tilt
- Neutral, equal WB
- Start with support
- Engage deep stabilisers - transversus abdominis
Bridging/spine curls – strength & flexibility

- Maintaining core position and strength as foundation
- Control the movement
- Flexibility of vertebral segments, aids balance
- Low back protection
Trunk rotation

- Elongate the deep stabilisers
- Oblique mobilisers
- Stable, neutral shoulder girdle
- Bed mobility and dressing
Facilitation

- Use proprioception
- Guide the movement
- Enhance recruitment
- Low threshold stimulus
Trunk control & strength

- Maintain hip and pelvis in neutral
- Keep shoulders and neck relaxed
- Dual abdominal action
- High intensity exercise
Assisted abdominals

- Safe strengthening of abdominals
- Reduced strain on neck
- Controlled spine, encouraging flexibility
Trunk mobility & weight transference

- Strong stable centre with increased movement
- Transfer of weight over base of support
- Trunk elongation and stretch
- Reduce tight tissues
Improve proprioception

- Stimulate trunk agility
- Promote balance reactions
- Stabilisations, challenge the system
- Recruit activity from small stimuli
Back extension

- Deep abdominals sustained to protect lower back
- Shoulder girdle stability & position
- Hip extensors & adductors
- Hip flexor stretch
Extension with length

- Strengthen extensors
- Recruit gluts first
- Lengthen joints
- Active stretching of flexors
- Pelvis held neutral
- Slow motor units
Applied postural set

- Change postural set to neutral & more applied
- Abductor strength
- Engaging trunk, neutral spine
Flexibility

- Relaxation of tight tissues
- Increase range of movement
- Contracture prevention
- Symmetrical activities
Facilitate flexibility

- Proprioceptive Neuromuscular Facilitation (PNF)
- Reciprocal relaxation
- Hands on to improve effectiveness
Facilitate strength

- Proprioceptive Neuromuscular Facilitation (PNF)
- Repeated contractions
- Ensure can stabilise first
Postural awareness, less support

- Reduce base of support
- Explore extremes of pelvic tilt
- Find neutral, lengthened position
- Ease of movement, low effort level
Postural stability challenged

- Reduce base of support further
- Add movement
- Maintain posture
- Girdle stability
Rhythmic stabilisations

- Challenge stabilisers
- Low load co-activity
- Hip or shoulder girdles
Core stability

- Simultaneous transversus abdominis and multifidus
- Postural control
- Pelvic stability
Functional strength

- Multi muscle groups
- Integrate hip adductors with trunk stability
- Functional activity
Challenge patterns

- Further challenge to maintain neutral posture
- Work the limb segments - Balls, Theraband
Progress recruitment

Unstable base of support
Facilitation

- Increased proprioception
- ‘Feel’ movement
- Target stability of trunk and hip rotators
Effective Stretching

- Lengthen spine and hamstrings
- Equal weight ischial tuberosities
- Static holds 20-30 seconds
Smooth trunk agility

- Relaxation
- Lengthening
- Strong centre
- Range of movement
- Better breathing
Combined muscle actions

- Combined muscle action:
  - Back extension
  - Hip adduction
  - Always from a stable centre/posture
Combined actions

- Combined muscle action:
- Hip extension
- Control anterior pelvic tilt

(TF - smaller box)
Combined actions

- Combined muscle action:
  - Hip adductors
  - Hip internal rotators
Combined actions

- Combined muscle action:
  - Hip abductors
  - Lateral pelvic shift, eccentric & concentric (stance phase)
Variation & challenge to create change

- Strengthen once someone has awareness, stability and control
- Change speed, need quick reactions
- Change range & repetitions
- Muscle adaptation
Assessing kinetic control – how do they move?

- Stabilisers
- Mobilisers
- Posture
- Control
- Recruitment
- Flexibility
- Proprioception
- Strength
- Centring/midline
- Flowing movement
- Alignment
- Co-ordination
- Relaxation
- Joint integrity
- Concentration
- Stamina
Early walking aids
Pre prosthetic exercise
PPAM AID

- Transtibial, through knee and long transfemoral
- Easy to apply
- Very cost effective
- 40 mmHg (NWB)
- No knee joint or foot
- Partial weight bearing
PPAM AID Precautions

- Pain
- Unhealed wounds
- Infected wound
- Flexion deformity (hip or knee > 30 degrees)
- Short femurs difficult
- Bilateral use (unless with prosthesis)
FEMURETT

- Sold through Ossur
- Consists of adjustable pylon with standard uniaxial ankle and foot
- 6 adjustable laminated quadrilateral sockets – left and right, small, medium, large
- Single axis knee joint – spring extension assist
- Single shoulder strap
- Knee can be locked or free
- Assessment tool for prosthetic rehabilitation
FEMURETT precautions

- Pain
- Open/unhealed wounds
- Wound infection
- Hip flexion contracture
FEMURETT - advantages

- Greater stability – contains short residual limb
- Full weight bearing – can progress to minimal walking aids
- Promotes early weight bearing through ischial tuberosity
- Prepares residual limb for rigid socket use
- Assessment tool for free knee use
- Early gait re-education with a bending knee
4 common TF movement faults

Uncontrolled movement:

- Femur into flexion at hip (stance) = poor hip extension, unequal strides
- Femur into abduction at hip (stance) = lateral trunk bend
- Lumbar spine into extension (stance) = excessive lordosis
- Pelvis into retraction (swing) = poor trunk rotation, uneven timing
- Test range, test control, re-educate into walking
Uncontrolled movement

- Uncontrolled movement of the femur into flexion at the hip (stance)
Test & correct
Applying the Thomas test!
Assess hip range & control in standing, includes lumbar spine
Uncontrolled movement

- Uncontrolled movement of the femur into abduction at the hip (stance)
Test & correct
Uncontrolled movement

Uncontrolled movement of the lumbar spine into extension (stance)
Test & correct
Uncontrolled movement

- Uncontrolled movement of the pelvis into rotation (swing)
Test & correct
Exercise sheets

Effective exercise needs:
- Supervision
- Correction
- Hands on
- Encouragement
- Repetition
- Progression
- An exercise sheet alone is not enough

(PIRPAG, OttoBock app)
THANK YOU ...

Gracias
Grazie
Merci
Obrigado!

شكراً

Dank
Ευχαριστώ

Bedankt
THANK YOU!