Amputee rehabilitation (FS-02)

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Integrating evidence into management of amputees in today’s world

Focused Symposium
The International Classification of Functioning, Disability and Health

HEALTH CONDITION

BODY STRUCTURE & FUNCTION IMPAIRMENTS

ACTIVITIES LIMITATIONS

PARTICIPATION RESTRICTIONS

ENVIRONMENT FACTORS

PERSONAL FACTORS
The importance of pre-operative patient-led participation and quality of life measures in persons undergoing lower limb amputation

Lonwabo Godlwana (South Africa)
Objective

To discuss the importance of undertaking patient-led participation and quality of life measures at the pre-operative stage in individuals about to undergo a lower limb amputation.
Introduction

• Diabetes is the leading cause of LLA (Lazzarini et al., 2012; Moxey et al., 2010; Nather et al., 2008; Stineman et al., 2008; Godlwana et al., 2008a)

• Trauma only accounts for a minority of cases.

• Age, gangrene and infection, comorbidities (eg stroke and IHD), complications (eg PVD and nephropathy), sensory neuropathy, ischaemia, endocrine control and pathogens (eg MRSA and staphylococcus) are identified as predictors for limb loss (Nather et al., 2008)

• Other factors of sex, race, duration of diabetes, smoking, alcohol, obesity, hyperlipidaemia were not predictive factors for limb (Nather et al., 2008)

• Low socioeconomic status in amputees (Godlwana et al., 2012, Bourdel-Marchasson et al., 2007, Ephraim et al., 2006)
What we need to know?

- There is dearth of literature on preoperative patient-led regarding the quality of life and participation levels in amputees

- Amputating a leg often follows conservative approaches to save the limb in dysvascular patients: e.g. foot care programmes, lifestyle modifications and revascularization

- Modifiable characteristics have a great potential to improve postoperative patient outcomes
The pre-operative amputee period

- The preoperative stage: premorbid and presurgical (Czerniecki et al., 2012; Norvell et al., 2011)

- Ambulation declines with BKA, AKA and TMT from premorbid-presurgical to post-amputation with no significant difference among levels of amputation (Czerniecki et al., 2012)

- Ambulation declines then improved during the intermediate post amputation stage from (6 weeks to 4 months) but doesn’t reach the premorbid ambulation state

- Mobility declines over time from premorbid state to a year after LLA (Norvell et al., 2011)

- Preoperative characteristics such as > 65 year or older, alcohol disorders, hypertension, anxiety or depression are associated with a lower success in regaining mobility postoperatively (Norvell et al., 2011)
What we did in our study

Participants (n=154)
   Pre-operative (pre-morbid)

Outcome measures
   Demographic questionnaire
   Barthel Index (BI)
   Participation Scale (P-Scale)
   EuroQol Quality (EQ-5D)

Ethical approval # M110124
## Participant demographics

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>Years</th>
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<tbody>
<tr>
<td>Age 25</td>
<td>52.8</td>
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<tr>
<td>50</td>
<td>58</td>
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<tr>
<td>75</td>
<td>65</td>
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<td>58.2(±9.8)</td>
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Males n= 100 (65%)
Females n = 54 (35%)
Physical activity levels

Barthel Index (n = 154)

- Frequency scores
  - 16: 29%
  - 17: 9%
  - 18: 22%
  - 19: 1%
  - 20: 2%

91% of participants have a Barthel Index score of 16.

Participation Scale (n = 154)

- Number of participants
  - No restriction: 120
  - Mild restriction: 20
  - Moderate restriction: 4
  - Severe restriction: 2
  - Extreme restriction: 0

Most participants (88%) have no restriction.
Where to from here?

- Patient education
- Foot care
- Lifestyle modification, poor adherence
- Social support
- Comorbidities
- Preoperative occupation & functional levels
- Social participation

Engkasan et al., 2012, Suckow et al., 2012, Corey et al., 2012 Henry et al., 2011
Asano et al., 2008, Deans et al., 2008, Burger & Marincek, 2007, Huang et al., 2005, Kuo et al., 2004
In conclusion:

- Preoperative functionality (activity levels, participation levels and quality of life) is generally high preoperatively. However, these high functional levels seen preoperatively are potentially misleading.

- Education on preventative lifestyle factors is still lacking.

- Health care programme involved with at-risk populations must target those modifiable patient characteristics in order to improve functional outcomes of activity level, participation levels and quality of life.
References


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The International Classification of Functioning, Disability and Health

- Health Condition
  - Body Structure & Function Impairments
  - Activities Limitations
  - Participation Restrictions
  - Environment Factors
  - Personal Factors

- Personal Factors

- Environment Factors
Balance control in persons with dysvascular and traumatic amputation

Prasath Jayakaran (New Zealand)
Objective

To outline the deficits in balance performance in persons with a lower limb amputation secondary to dysvascular complications. The associated implications for rehabilitation will also be discussed.
Size of the problem

0.57 million lower limb amputees (US - prevalence)
  • >46% are dysvascular (PVD/diabetes)

3767 lower limb amputees (NZ – prevalence*)
  • Incidence/annum ~ 400

*NZ Artificial Limb Service- Annual Report 2013-14
In New Zealand*...

Total amputations (N = 4311)

- Vascular/diabetic
- Trauma
- Other causes

New referrals ~350 per annum

- Vascular/diabetic
- Trauma
- Other causes

*NZ Artificial Limb Service - Statistics 2013-14
Dysvascular versus other amputation aetiologies

- Decreased balance ability (Hermodsson, 1994; Kanade, 2008)
- Decreased functional mobility (Arwert, 2007)
- Decreased quality of life (Harness, 2001)
- Take longer time in rehabilitation (Ries, 2007)
Quality of life

SF 36 scores

Trauma (9 studies)  Vascular (3 studies)

- Physical functioning
- Role Physical
- Pain
- General health
- Energy/vitality
- Social functioning
- Role emotional
- Mental health
In theory...

Amputation in general:
Disruption of somatosensory function
Require compensation from other sensory systems (Geurts, 1992)

Dysvascular amputation:
Compromised neuro-vascular function (Quai, 2006)
Impact the ability to relearn postural strategies
Study 1 - Sensory Organization Test

Equilibrium score
• Percentage measure of balance

Strategy score
• Percentage measure of the strategy trend

Image courtesy of NeuroCom International Inc., US
Strategy score

Percentage measure of strategy

Conditions

Trauma (n = 6)  Dysvascular (n = 6)

P = 0.04  P = 0.03  P = 0.02
Study 2

Aim
To compare the muscle control strategies between traumatic and dysvascular amputees in dynamic sensory conditions

Design
Cross-sectional observational study
Sensory Organization Test

EQUITEST® - force platform

**EMG measures** *(Noraxon TeleMyo™ 2400T G2)*

- Bilateral rectus femoris
- Bilateral biceps femoris
- Sound side tibialis anterior
- Sound side medial gastrocnemius

*Image courtesy of NeuroCom International Inc., US*
Variables of interest

Centre of pressure (Prieto, 1992)
- Mean velocity
- Root mean square distance

EMG measures
- Co-contraction index (Inglis, 1994)
  *Ankle – tibialis anterior/medial gastrocnemius*
  *Knee – rectus femoris/medial hamstrings*

- Average muscle activity for 20s window
- Normalise to condition 1
  Ex: C2/C1 (Fransson, 2007)
- Co-contraction index
# Participant demographics

<table>
<thead>
<tr>
<th></th>
<th>Traumatic (9)</th>
<th>Dysvascular (9)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median (IQ)</td>
<td>Median (IQ)</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>69.0 (15.0)</td>
<td>73.0 (9.0)</td>
</tr>
<tr>
<td>Gender (M:F)</td>
<td>9:0</td>
<td>6:3</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.0 (4.58)</td>
<td>26.11 (4.58)</td>
</tr>
<tr>
<td>Use of prosthesis (years)</td>
<td>24.0 (24.0)</td>
<td>8.0 (7.87)</td>
</tr>
<tr>
<td>Locomotor Capability Index</td>
<td>49.33 (5.33)</td>
<td>56.0 (0.0)</td>
</tr>
</tbody>
</table>
Differences in centre of pressure

Traumatic amputees

Dysvascular amputees
Co-contraction index

Ratio:
Agonist/antagonist = 1
Agonist/antagonist < 1
Agonist/antagonist >1

Ankle co-contraction index – significant for conditions 4, 5 and 6
P<0.05
Key findings

Condition 4 - manipulation of somatosensory system

Condition 5 - manipulation of somatosensory minus visual input

Condition 6 - manipulation of somatosensory plus visual input
Why the difference...?

Co-contraction Fails (Okada, 2001)

Diminished ability to process altered sensory information
  • Visual/somatosensory (Barnett, 2014)

Diminished muscle strength/peripheral neurovascular function
  • Unable to generate ankle torque (Manchester, 1989)

Duration of prosthetic use
Key clinical implications

Dysvascular amputees employ different postural strategies (co-contraction)
  • when exposed to visual challenges/ unstable support surfaces

Discrepancies in postural strategies may persist beyond the early rehabilitation phase

The observed differences in postural strategies suggest the need for tailored rehabilitation for individuals with dysvascular conditions and those with a traumatic lower limb amputation
THANK YOU!
Special thanks to…

Associate Prof Gill Johnson and Prof John Sullivan

NZ Artificial Limb service – for funding the studies

Dunedin Artificial Limb centre staff – recruitment
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The prevalence and characteristics of low back pain subsequent to lower limb amputation

Hemakumar Devan (New Zealand)
Objective

To outline the prevalence and biomechanical features attributed to low back pain in persons with a lower limb amputation due to non-vascular related causes.
Trauma versus vascular amputation

Trauma

Vascular amputation
Musculoskeletal disorders in non-vascular amputation

• A major rehabilitation goal is to enhance prosthetic mobility (Esquenazi, 2004)

• Musculoskeletal conditions are increasingly common (Gailey et al., 2008, Devan. et al., 2012)

• Low back pain is a common secondary disability following amputation (Ehde et al., 2005)
Exploring pathways to low back pain

- Biomechanics Study
- Focus Groups
- National Survey
- Causal-beliefs of people with LBP
- LBP prevalence & activities aggravating LBP
- Spinal movement asymmetries with and without LBP
Focus groups

What people with lower limb amputation perceive as potential contributing factors to their low back pain?
‘I think part of it is that it’s sort of a natural gait... even though it’s as good as it can be, you don’t walk naturally’

‘One was the action of the foot and the second was the angle the foot actually sit on the ground and so that has reduced my back pain significantly’

‘Over to back pain, I think its fitness, because fitness means you deal with things much better both psychologically and physically’

When you're tired, you're probably not concentrating so much so you do have to be more aware of how you walk..’

Unnatural movements
Being aware of posture and fatigue
Prosthesis as a tool
Physical fitness
National Survey

To investigate low back pain prevalence and common functional activities aggravating low back pain

Low back pain prevalence in New Zealand

Low back pain prevalence
(N = 208)

- Yes: 67%
- No: 33%

ADL restriction due to LBP
(N = 137)

- No: 55%
- Yes: 45%
Low back pain prevalence by amputation levels

Transfemoral amputation (N = 78)
- Yes: 72%
- No: 28%

Transtibial amputation (N = 130)
- Yes: 64%
- No: 36%
Comorbid pain conditions (N = 208)

- Low back pain: 67%
- Phantom limb pain: 63%
- Non-amputated limb pain: 56%
- Residual-limb pain: 46%
Low back pain intensity (N = 137)

- Mild (1-4): 34.5
- Moderate (5-7): 34.5
- Severe (8-10): 31
Functional activities aggravating low back pain (N = 208)
Spinal kinematics study

To investigate the differences in spinal and pelvic kinematics between persons with TFA and TTA, with and without low back pain
Spinal kinematics study

To investigate the differences in spinal and pelvic kinematics between persons with TFA and TTA, with and without low back pain
Spinal kinematics in TFA with and without low back pain (N = 5)

Transverse plane
Spinal kinematics in TFA with and without low back pain (N = 5)
Spinal kinematics in TTA with and without low back pain (N = 12)

No LBP group (N = 5)

LBP group (N = 7)
Implications for practice and research

• Low back pain is highly prevalent in persons with TFA and TTA.

• Participants with ongoing low back pain believe ‘unnatural movements’ at the back and lower limb are contributing factors

• Preliminary evidence indicates spinal movement asymmetries in persons with low back pain during gait

• Early rehabilitative strategies focusing on movement quality in functional activities of gait, lifting and sit to stand
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Environmental and personal factors impacting on lower limb amputees receiving physical rehabilitation in emerging countries and countries of war

Sara Drum (Ethiopia)
Objective

To describe the common barriers which confront persons with an amputation in accessing physical rehabilitation services and their successful re-integration into society at the local service level in developing countries and areas of conflict.
ICRC in Ethiopia

‘impartial, neutral, independent organization working to protect the lives and dignity of victims of armed conflict and to provide them assistance’

War of independence, Eritrea 1961-1991

Dergue regime 1974-1991

Ethio-Eritrea war 1998-2000
Physical Rehabilitation Program

Labour and Social Affairs

UN Convention of Rights for Persons with Disabilities, Ethiopia 2010

10 physical rehabilitation centres supported in 2014

2344 amputees accessed multidisciplinary services

751 amputees new to services
Environmental Barriers

Geographical size of Ethiopia
- Rural versus urban
- Travel distances, transport availability and costs
- Ethnic regions

Weak primary health care and referral to physical rehabilitation services

Limited access to prosthetic technology (Bashford, 2014)

Lack of rehabilitation professionals
Personal Barriers

Lack of awareness of physical rehabilitation services throughout the country

Financial resources of the individual (Banks & Polack, 2014)

Priorities within the family
  • male versus female
  • income earner
  • absence from the home for rehabilitation
  • need for an assistant
How do we reduce barriers?

- Improving accessibility
- Material provision
- Professional education
Improving Accessibility

Decentralisation of services

Three new physical rehabilitation centres supported from 2014

Transport and food reimbursement for the most vulnerable

Mapping of services for persons with disability (Bashford, 2014)

Facilitate awareness and coordination about disability and rehabilitation services (Bigelow et al., 2004)

Donation of prosthetic technology
Material Provision

Currently
ICRC importation and donation
ICRC supported project for the development of a supply chain for rehabilitation materials (prosthetic, orthotic, physiotherapy, wheelchairs)
Cost analysis of prosthetic services

Future Goal
Ethiopian government supply chain
Economic ownership shared within Ethiopia: payment for services by service users, social protection, insurance companies and donors
Professional Education

**Short Term** on the job training/short courses for physiotherapists and prosthetists

**Medium Term**
Prosthetics and Orthotics Technical College, Addis Ababa
Supported Clinical Placements for BSc. Physiotherapy Students (Gondar University)
ICRC / Physiopedia / WCPT MOOC: Rehabilitation for Lower Limb Amputees
Informal support to professional associations:
Ethiopian Physiotherapy Association (member of WCPT) and Ethiopian Prosthetic & Orthotic Association

**Long Term**
Prosthetics and Orthotics Bachelor Degree (Addis Ababa University)
Upgrading of prior physiotherapy diploma graduates to degree status (Ethiopian Government)
How do we measure our performance?
Service User Feedback

Access to services
Quality of service
Socio-economic impact of the service
Accessibility: concerns about accessing services

2014 Results
Quality: mobility with and without devices

Mobility without the device
49% limited to household ambulation

Mobility with the device
76% very high ambulation capacity and active within the community
Social inclusion: importance of the device

Interacting within your community

- Very Important: 78%
- Important: 15%
- More or Less Important: 7%

2014 Results
Social inclusion: importance of the device

Earning a living

2014 Results

- Very Important: 49.1%
- Important: 9.1%
- More or Less Important: 14.5%
- Not Important: 12.7%
- N/A: 14.5%
What about Physiotherapy performance?

Improvement in walking speed (Rau et al., 2007)
Post discharge decline in functional performance (Van Twillert et al., 2014)

ICRC Physiotherapy Standards of Practice with Teesside University

Outcome measures
In conclusion

Physical Rehabilitation Programme works to identify and reduce environmental and personal barriers to ensure access for lower limb amputees to quality and sustainable physical rehabilitation services.

Use of existing and new tools to measure the progress of the service and impact of the service on the users at an individual, centre, national and international level.

Embedding of the Physiotherapy Standards of Practice within the physical rehabilitation program strategy.
Acknowledgements

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ICRC Physical Rehabilitation Program colleagues

Persons with disability within Ethiopia
References


Bashford, T., 2014. Anaesthesia in Ethiopia: providers’ perspectives on the current state of the service. Tropical Doctor, 44(l) 6-13


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The International Classification of Functioning, Disability and Health

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Active participation is the primary goal for all persons with a major lower limb amputation.

Early education of at-risk individuals is an important goal for health professionals in order to optimise long-term functional outcomes.

Rehabilitation programmes for persons with an amputation due to dysvascular complications require a more tailored approach if they are to reach their full potential.

Continued
Individuals with a lower limb amputation need to be educated about the underlying biomechanical issues associated with common functional tasks in order to minimise the risk of developing musculoskeletal problems such as low back pain.

The experience of the ICRC Physical Rehabilitation Programme is that sustainable national services designed for individuals with a major amputation in countries with conflict or political unrest are greatly enhanced by education and awareness raising at the local level.
Time for discussion