



International Society for Prosthetics and Orthotics  
United Kingdom Member Society

## ANNUAL SCIENTIFIC MEETING & EXHIBITION

Royal College of Physicians, London  
3<sup>rd</sup> & 4<sup>th</sup> October 2014



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## Welcome to the 42<sup>nd</sup> Annual Scientific Meeting of ISPO UK MS

On behalf of the ISPO Executive Committee and the Scientific Sub Committee, we welcome you to the Royal College of Physicians, London for the 2014 Annual Scientific Meeting and Exhibition. This is your time to connect with your colleagues, earn educational credits and explore ideas and initiatives to improve patient care.

It has been a pleasure to organise this year's programme with the support of the team at Queen Mary's Hospital, Roehampton. We have focused on dedicated themes for each session aiming to satisfy CPD requirements across the disciplines. The key topics are amputation surgery, multi-limb amputee rehabilitation, appraisal of socket techniques, recent advances of prosthetic components and evidence based prosthetic practice.

We record our thanks to Chas A Blatchford & Sons Ltd and the Orthotic Education and Training Trust for their continued sponsorship of the Blatchford Lecture and OETT Lecture respectfully. We have also, this year, been fortunate to obtain additional funding from Opcare, Ottobock and RSL Steeper which has allowed us to invite well known experts to contribute to our meeting.

We take this opportunity to thank all presenters and speakers who are contributing to the programme as well as those who have submitted poster presentations and congratulations to Professor Rajiv Hanspal, the 2014 recipient of the George Murdoch Medal for his outstanding research and contribution to amputee rehabilitation.

The OETT lecture is complimented by topics on orthotic applications in neurological rehabilitation. The ISPO committee is keen to stimulate the active participation of orthotists and it is hoped that this dedicated orthotic programme will be the catalyst for improving numbers attending our future annual meetings.

The committee is keen to receive feedback and suggestions from delegates, particularly regarding the deviation of the traditional balance between invited lectures and free papers. Please complete the evaluation form before leaving the meeting. Your comments will help shape the format of future meetings.

This meeting could not take place without the support and sponsorship of the commercial companies, so please do ensure that you take time to visit the exhibition stands and engage with our exhibitors. Thanks are extended to our Platinum Sponsor - Opcare, Gold Sponsor - Ottobock, Silver Sponsor - Irwin Mitchell and Bronze Sponsor - Allergan Pharmaceuticals and supporter, North Sea Plastics. Their sponsorship contributes enormously towards this high quality meeting in London.

Along with the ISPO UK committee, we thank Irene Cameron who works extremely hard as our Executive Secretary, providing a huge amount of support throughout the year, particularly during the organization of our conference.

And, finally, we wish to express our sincere thanks to all of you, the delegates, for your interest, support and participation at this meeting. We wish you an outstanding experience at this Annual Scientific Conference and invite you to enjoy both its educational and social opportunities.



Lal Landham  
Chair ISPO UK MS



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# CONFERENCE PROGRAMME

Friday 3 October	
0830 hrs	Registration & Refreshments
0930 hrs	Welcome by Dr Lal Landham, Chair, ISPO UK MS
Prosthetic & Orthotic Sessions to run concurrently throughout Friday 3 October as follows:-	
PROSTHETIC SESSIONS	
0945 hrs	<b>Theme: Amputation Surgery</b> Chair: Mr David Ward, Consultant Orthopaedic Surgeon, Queen Mary's Hospital <b>"Gritti Stokes Amputation versus Transfemoral Amputation in Peripheral Arterial Disease"</b> W Al-Jundi, Specialist Registrar in Vascular Surgery, Sheffield Vascular Institute, Sheffield
1015 hrs	<b>Free Paper Session</b> <b>"Examination of Amputation Technique in Knee Disarticulation Amputees"</b> L Duff, DMRC Headley Court, Headley <b>"Outcomes of knee disarticulation and the influence of surgical techniques in dysvascular patients: report of a systematic review"</b> T Murakami, National Centre for Prosthetics & Orthotics, University of Strathclyde, Glasgow <b>"Phantom Limb Pain (PLP) in lower limb amputees: the first steps to confirm the pain mechanism – provisional results"</b> Dr C Richardson, School of Nursing, Midwifery & Social Work, University of Manchester, Manchester <b>"Military Surgical Stump Revision: The East Grinstead Experience"</b> J A Jeevaratnam, Queen Victoria Hospital NHS Foundation Trust, East Grinstead
1115 hrs	<b>Exhibition &amp; Refreshments</b>
1145 hrs	<b>Blatchford Lecture 2014</b> <b>"From the Battlefield to Home: Care of the Combat Amputee"</b> Col. Donald A Gajewski, MD, Director, Center for the Intrepid, San Antonio, Texas, USA
1245 hrs	<b>"Role of revision/reconstructive surgery"</b> Lt Col Tania Cubison, FRCS (Plast), RAMC, Queen Victoria Hospital, East Grinstead
1315 hrs	<b>Exhibition &amp; Lunch</b>
1415 hrs	<b>Theme: Multi-limb amputee rehabilitation</b> Co-chairs: Ms Laura Burgess, ISPO UK MS Honorary Treasurer & Immediate Past Chair Mr Stuart Reeves, Queen Mary's Hospital, London <b>"Holistic management of multi-limb amputees"</b> Led by Ms Sarah Smith, Therapy Team Leader, Roehampton, London <b>"Rehabilitation of multi-limb amputees and transitioning from military to civilian life"</b> Ms Kate Sherman, Clinical Lead Physiotherapist, DMRC Headley Court, Surrey Mrs Allyson Ballard – Complex Trauma OT, DMRC Headley Court, Surrey Mr Matt Webb – Triple amputee
1545 hrs	<b>Exhibition &amp; Refreshments ISPO UK MS Annual General Meeting</b>
1615 hrs	<b>Free Paper Session</b> <b>"A Survey on Prosthetic Abandonment in Upper and Lower Limb Amputees"</b> Dr R Pabbineedi, University Hospital of South Manchester NHS Foundation Trust, Manchester <b>"Quality of Life and Factors Associated with Successful C-Leg Use"</b> P Norton, Belfast Health & Social Care Trust, Belfast, Northern Ireland
1645 hrs	<b>Plenary Session</b> <b>"Multi-limb rehabilitation: a user's perspective"</b> Mr Giles Duley
1800 hrs	<b>Exhibition &amp; Close of Meeting (Day 1)</b>
1900 hrs	<b>Drinks Reception</b> sponsored by Irwin Mitchell LLP
1930 hrs	<b>ISPO UK MS Dinner</b> sponsored by Ottobock



Friday 3 October

## ORTHOTIC SESSIONS

0945 hrs	<b>Theme: Orthotics in Neurological Impairment</b> Chair: Mr Simon Lalor, Lead Orthotist, Queen Mary's Hospital
0945 hrs	<b>OETT Lecture 2014</b> <b>"Improving the Evidence Base for the Orthotic Management of Lower Limb in Neurological Conditions"</b> Ms Karyn Ross, Teaching Fellow, National Centre for Prosthetics & Orthotics, University of Strathclyde, Glasgow
1030 hrs	<b>Free Paper Session</b> <b>"A survey of AFO use, physical and psychological well-being in NHS Greater Glasgow and Clyde"</b> C McMonagle, National Centre for Prosthetics & Orthotics, University of Strathclyde, Glasgow <b>"The use of KAFOs for management of Inclusion Body Myositis (IBM)"</b> P Charlton, Peacocks Medical Group, Newcastle
1110 hrs	<b>Exhibition &amp; Refreshments</b>
1130 hrs	<b>"KAFO fabrication: tips and tricks"</b> David Buchanan, Andy Dewsbury & Tim Cooney
1200 hrs	<b>"Functional electrical stimulation: state of play"</b> Prof David Ewins, Queen Mary's Hospital, London
1230 hrs	<b>"Functional electrical stimulation: an orthotic perspective"</b> Samuel Walmsley, The London Orthotic Consultancy Ltd, London
1250 hrs	<b>Company Presentations</b> <b>"Actigait for Drop Foot"</b> Dr Salim Ghoussayni, Business Development Director, Neurorehabilitation, Ottobock  <b>"BOTOX® (botulinum toxin type A) in the treatment of ankle disability due to lower limb spasticity associated with stroke in adults"</b> Stefan Ivanavicius, PhD, Medical Affairs UK & Ireland, Allergan
1315 hrs	<b>Exhibition &amp; Lunch</b>
1415 hrs	<b>Theme: Orthotics in Neurological Impairment</b> Chair: Paul Charlton, Peacocks Medical Group  <b>"Clinically applicable outcome measures to evaluate AFOs in post-stroke hemiplegia"</b> Joshua Young, Orthotist, Queen Mary's Hospital, London
1435 hrs	<b>"Care pathways of lower limb orthotic management in CP in the NHS"</b> Simon Lalor, Lead Orthotist, Queen Mary's Hospital, London
1455 hrs	<b>"Upper limb orthotics in neurological impairment"</b> Ms Lydia Dean, Clinical Specialist Occupational Therapist, Queen Mary's Hospital, London
1515 hrs	<b>"The Significance of Orthotic Intervention in the Treatment and Prevention of Type 2 Diabetes"</b> Gordon Steele, Lead Orthotist, Preston
1535hrs	<b>Exhibition &amp; Refreshments</b> <b>ISPO UK MS Annual General Meeting</b>
1605 hrs	<b>"Selective dorsal rhizotomy in cerebral palsy"</b> Mr Kristian Aquilina, Consultant Paediatric Neurosurgeon, Great Ormond Street Hospital, London
1635 hrs	<b>Return to Main Lecture Theatre for Plenary Session</b>
1900 hrs	<b>Drinks Reception</b> sponsored by Irwin Mitchell LLP
1930 hrs	<b>ISPO UK MS Dinner</b> sponsored by Ottobock

Saturday 4 October	
0830 hrs	<b>Registration</b>
0900 hrs	<b>Welcome by Prof Saeed Zahedi, Vice-Chair, ISPO UK MS</b>
	<b>Theme: Socket Technology &amp; Advances</b> Co-chairs: Prof Saeed Zahedi, ISPO UK MS Vice-Chair & Mr Michael O'Byrne, CEO, Opcare Ltd <b>"Managing combat amputees: prosthetic experience"</b> John Ferguson, Chief of Prosthetics, Intrepid, San Antonio, USA
0945 hrs	<b>Company Presentations</b> <b>"Partnership in Practice" – Opcare Ltd</b>
1015 hrs	<b>Exhibition &amp; Refreshments</b>
1045 hrs	<b>"Transfemoral socket fit and design: an appraisal and discussion"</b> Panel Session chaired by John Sullivan    Panellists: Richard Nieveen, Richard Hirons, John Ross & Joe McCarthy
1145 hrs	<b>George Murdoch Prize Lecture</b> <b>"Rehabilitation for Amputation and Limb Deficiency – The People, The Process &amp; The Product"</b> Professor Rajiv S Hanspal, Royal National Orthopaedic Hospital, Stanmore, Middlesex
1215 hrs	<b>Free Paper Session</b> <b>"Comparison of the High-Fidelity Interface and a traditional interface using subjective and functional outcome measures: A case study"</b> R Alley, Biodesigns, Westlake Village, California, USA <b>"Influence of stump/socket relative movement on gait analysis for above knee amputees – A case study"</b> J Tang, Faculty of Engineering & the Environment, University of Southampton, Southampton <b>"The Effect of a Two-Dimensional (2-D) Motion Analysis System on the Reliability of the Prosthetic Observational Gait Score (POGS)"</b> Dr A McGarry, National Centre for Prosthetics & Orthotics, University of Strathclyde, Glasgow
1300 hrs	<b>Exhibition &amp; Lunch</b>
1345 hrs	<b>Theme: Recent Advances on Prosthetic Technology</b> Chair: Prof Jai Kulkarni, University Hospitals of South Manchester <b>"Enhancing measurement of prosthetic outcomes: new tools to quantify the patient's experience"</b> Brian J Hafner, Associate Professor, University of Washington, Seattle, WA, USA
1430 hrs	<b>Free Paper Session</b> <b>"3-directional load sensing system for stump socket interface"</b> P Laszczak, Faculty of Engineering & the Environment, University of Southampton, Southampton <b>"Influence of an Integrated Control Approach on Ramp Descent Control Strategies for Transfemoral Gait"</b> N Stech, Endolite Innovation Centre, Basingstoke <b>"A New Approach for Biomechanical Analysis of Prosthetic Foot Function"</b> G Conway, DMRC Headley Court, Headley <b>"Development of an in-patient service for lower limb amputees"</b> K Crawford, University Hospitals South Manchester NHS Foundation Trust, Manchester <b>"New socket technology for upper limb amputees: trans-humeral case studies"</b> L Holding, Aintree University Hospital, Liverpool
1530 hrs	<b>"NHS Commissioning of services and prostheses"</b> Rachel O'Connor, Director – National Programme of Care (Specialised Trauma), Medical Directorate, NHS England
1605 hrs	<b>Presentation of Prizes</b>
1615 hrs	<b>Close of Meeting</b> by Dr Lal Landham, Chair, ISPO UK MS <b>Refreshments</b>

## GUEST SPEAKERS

### Col Donald A Gajewski

Col Donald A Gajewski is a native of Erie, Pennsylvania. He graduated from Cathedral Preparatory High School in 1985; completed studies in Biology at Harvard University in 1989 and received his Doctor of Medicine degree from Temple University School of Medicine in 1994.



Col Gajewski was commissioned into the Army Medical Corps in May of 1994 and was subsequently assigned to Walter Reed Army Medical Center (WRAMC) where he completed an internship in General Surgery in 1995. After one year of serving as a General Medical Officer in South Korea, he returned to Walter Reed to complete an Orthopaedic Surgery residency from which he graduated in 2001. He then went on to receive fellowship training in Musculoskeletal Oncology from the University of Miami School of Medicine in 2002.

His assignments include staff surgeon at WRAMC where he was Director of Musculoskeletal Oncology and amputee surgical care (2002-2008) and Residency Program Director (2006-2007). He served as Chief of the Department of Orthopaedics and Rehabilitation at Landstuhl Regional Medical Center (LRMC) in Germany from 2008 to 2009 and then Chief of Surgery at LRMC from 2009 to 2010.

Dr. Gajewski has been deployed twice; first in support of Operation Iraqi Freedom in 2004 with the 31<sup>st</sup> Combat Support Hospital and then in Afghanistan in 2010-2011 with the 555<sup>th</sup> Forward Surgical Team. He has been involved with combat casualty care since the beginning of the Global War on Terror at all echelons of care.

Currently Col Gajewski serves as Director of the Center for the Intrepid (CFI) in San Antonio, TX. The CFI is a multi-million dollar, state-of-the-art physical rehabilitation center at Brooke Army Medical Center that serves military personnel who have been catastrophically disabled in operations in Iraq and Afghanistan, and veterans severely injured in other operations and in the normal performance of their duty. The 60,000 square foot Center was funded by donations from over 600,000 Americans through the Intrepid Fallen Heroes Fund. Their generosity expresses the profound appreciation America has for its courageous servicemen and women who defend freedom.

### Lt Col Tania Cubison



Miss Cubison is based at the Queen Victoria Hospital at East Grinstead and also works at the McIndoe Surgical Centre, a private hospital on the same site. She is a fully accredited Consultant Plastic surgeon, a full member of The British Assoc of Plastic Reconstructive and Aesthetic Surgeons (BAPRAS) and was awarded the McGregor Gold Medal in her FRCS (Plast) examination. As a general plastic surgeon, Tania has a specialist interest in burn care and scar revision, and a second special interest in trauma reconstruction. As one of a small number of regular army plastic surgeons Lt.Col.Cubison has an operational role and is currently part of a team caring for soldiers injured whilst deployed in Afghanistan.

Tania is an honorary Senior Clinical Lecturer at the University of Brighton, and is the Research Lead for Burns and Wound healing, and the Clinical Lead in Paediatric Burns at the Queen Victoria Hospital. She has undertaken a number of studies to evaluate burn healing, and in using many new techniques that may help reduce scarring. Tania is very involved in teaching burn care in both military and civilian settings, and is also a key member of the prevention committee of the British Burn Association.

### The Roehampton Team

The clinical team at Roehampton has been established for many years, consisting of consultant in rehabilitation, clinical nurse specialist, expert prosthetists, clinical specialist therapists, clinical psychologist, social worker and dietician. Working closely together has provided the opportunity for learning and development and enabled the team to develop problem solving strategies building on past experience. Many of the team have presented at conferences including, ISPO both nationally and internationally, BAPO, BACPAR, BRSM, COT, TIPS, Vascular Society.



### **Kate Sherman**



Kate is a Clinical Lead Physiotherapist, and has worked at the Defence Medical Rehabilitation Centre since 2002 in the Complex Trauma and Physiotherapy services. She is one of six winners of the Barclays Women of the Year Award, all of whom are dedicated medical professionals who have worked tirelessly treating injured and wounded military personnel and civilians in hospitals in the UK as well as in the field.

### **Giles Duley**

Giles Duley was born in 1971 in London. After 10 years as an editorial photographer in the fashion and music industries in both the US and Europe, Duley now focuses his work on humanitarian projects. Working with well respected charities such as Medecins Sans Frontiers, IOM and UNHCR to highlight lesser-known stories deserving of public attention and action. Although documenting challenging, and at times, horrific situations, Duley captures the strength of those who fight their adversity rather than succumb. His photographs draw the viewer to the subject, creating intimacy and empathy for lives differing from ours only in circumstance. In 2011, whilst on patrol with 75th Cavalry Regiment, United States Army in Afghanistan, Duley stepped on an improvised explosive device (IED). He was severely injured, losing both legs and an arm. He is now back working.



### **Karyn Ross**

Karyn Ross is an orthotist/prosthetist working as a teaching fellow in the National Centre for Prosthetics and Orthotics, University of Strathclyde, Scotland. She has 24 years teaching, research and clinical experience in many areas of lower limb orthotics including stroke, cerebral palsy, knee-ankle foot orthotics and stance control. She is the chair of an orthotics advisory group for Arthritis Research UK and is currently involved in a number of research projects in the management of arthritic conditions.

### **Tim Cooney**

Tim Cooney has worked as an orthotist in both Australian and United Kingdom teaching hospitals for over ten years. He has a special interest in materials science culminated in a role with Orthotic Composites. Orthotic composites is a specialist orthotic/prosthetic central fabrication and design company focused on composite technology.

### **Professor David Ewins**

David Ewins is a Professorial Research Fellow in Biomedical Engineering at the University of Surrey and Consultant Clinical Scientist and Gait Laboratory Manager at Queen Mary's Hospital Roehampton. His research interests include Functional Electrical Stimulation, Movement (Gait) Analysis and Prosthetics & Orthotics.



### **Samuel Walmsley**

Sam qualified in 2001 with a degree in Orthotics and Prosthetics from Salford University. After graduating he took up a post as orthotist at Basingstoke NHS trust where he received post graduate training in paediatric orthotics. He later joined the team at Queen Mary's Hospital, London and developed wider skills which included Adult and Paediatric Neuro rehabilitation and complex foot and ankle orthotics. He is also a fully qualified Vabene posture therapist.

### **Joshua Young**

Joshua Young works as an orthotist at Queen Mary's Hospital, Roehampton. He graduated from the University of Salford in 2013 and has since presented work at BAPO conference (2014) and the 2<sup>nd</sup> European Polio Conference (2014). As a member of the BAPO professional affairs committee he has written a leaflet titled 'Orthotic Treatment: the Diabetic Foot', and is currently coordinating a project on the use of clinical outcome measures by prosthetists and orthotists.

### **Simon Lalor**

Simon Lalor is the Clinical Lead Orthotist at Queen Mary's Hospital in Roehampton, UK. He graduated from La Trobe University in Melbourne, Australia in 2001. Whilst working in Australia, Ireland and the UK he has specialised in the lower limb orthotic management of cerebral palsy.

### **Lydia Dean**

Lydia Dean qualified as an Occupational Therapist in July 1977 and has practised in the field of physical disability, specialising in hand and upper limb injuries since 1985. She is a well known trainer in hand therapy and orthotics having worked extensively at Queen Mary's Hospital in Roehampton with patients with neurological or challenging hand conditions, including children.



### **Kristian Aquilina**

Mr Aquilina is a Consultant Paediatric Neurosurgeon working at Great Ormond Street Hospital. He completed a clinical fellowship in paediatric neurosurgery at St Jude's Children's Research Hospital and Le Bonheur Children's Medical Centre, Memphis, Tennessee. He completed his training in 2009. Mr Aquilina has published extensively with over 40 publications and four book chapters. He has developed a special interest in selective dorsal rhizotomy.

### **John Ferguson**

John Ferguson is the Chief Prosthetist at the Center for the Intrepid at San Antonio Military Medical Center, USA. The Center for the Intrepid is one of three Department of Defence Amputation Care centers specializing in the complex rehabilitation of combat injured amputees. He has been involved in the clinical application of the latest technological advancements available to the lower limb amputee. He is a former instructor for UT Southwestern and was the program director for the UW Prosthetics Orthotics Division prior to joining BAMC in 2004. He has authored multiple book chapters, journal publications and has spoken both nationally and internationally on prosthetic care for the treatment of those with multiple limb amputations.



### **Brian Hafner**

Prof Hafner is a UW Associate Professor with the University of Washington in Seattle, WA USA. He has an interest in critical evaluation of the literature, systematic literature review and evidence based practice. His current research projects focus on the development of valid and reliable patient reported outcome measures and the evaluation of outcomes associated with the use of advanced prosthetic knee technologies.

## ABSTRACTS

Title: **Examination of Amputation Technique in Knee Disarticulation Amputees**

Presenter: **Lynsey Duff, Prosthetist, Miss**

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### Background

Knee disarticulation (KD) amputees comprise 1% of the amputee population in the world<sup>1</sup>. Due to the small number of knee disarticulation amputations performed, the amputation technique is inconsistent. The purpose of this investigation is to examine the preferred technique for KD amputation with regard to patella preservation and assess if removing the patella reduces the need for revision surgery.

### Method

A total of 49 KD amputees were identified; 17 unilateral KD and 32 bilateral amputees with 10 of those being bilateral KD. X-rays following original amputation were examined to confirm amputation technique with regards to preservation or removal of patella. This information was cross-referenced with the surgical notes. Clinical records were then examined to assess if revision surgery was required and the cause of revision surgery noted.

### Results

Out of the 61 KD amputations examined, x-rays were available for 43. The patella was left in situ in 60% (n=26) of the KD amputations and 38% (n=10) of those required revision surgery. Of the 38% that had revision surgery, 40% (n=4) had revision surgery due to problems caused by the patella.

### Conclusions

The results indicate it is more common to leave the patella in situ than remove it in KD amputation. If the patellae had been removed in all of those examined, the need for revision surgery may have been reduced by 29%. There is insufficient data to provide a recommendation of amputation technique in knee disarticulation. A larger population is required to draw more definitive conclusions.

### References

1. The Paediatric Orthopaedic Society of North America (2014) A Manual for the Rehabilitation of People with Limb Amputation [Online] 2004. Available from- <http://www.posna.org/news/amputations.pdf> [Accessed: 23.05.14]



**Title:** Outcomes of knee disarticulation and the influence of surgical techniques in dysvascular patients: Report of a systematic review

**Presenter:** Tsurayuki Murakami, Prosthetist/Orthotist, Mr; National Centre for Prosthetics and Orthotics, University of Strathclyde

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**Other Authors:** Kevin D.Murray, PhD; National Centre for Prosthetics and Orthotics, University of Strathclyde

## Background

Dysvascularity is the main cause of lower limb amputations in Scotland and there is an insignificant proportion (1.7%) of knee disarticulations (KD),<sup>1</sup> despite the benefits of the amputation.

## Objectives

The outcomes of KD and its associated surgical techniques will be evaluated based on quality of stump, functional outcomes, prosthetic ambulation and gait biomechanics, to determine if a greater rate of KD can be justified among dysvascular patients.

## Methods

Medline, Embase, Cochrane Library and ScienceDirect were searched for the relevant literature based on a pre-specified eligibility criteria (Table 1). Studies were critically appraised and data extraction/synthesis were carried out.

**Table 1. Eligibility Criteria**

Studies	<ol style="list-style-type: none"> <li>1. Randomised controlled trials, controlled clinical trials, observational studies, and non-analytical studies.</li> <li>2. English publications in peer-reviewed journals in the last 25 years.</li> <li>3. Reviews, expert opinions and studies with abstracts only are excluded.</li> </ol>
Participants	Dysvascular patients of all ages.
Intervention	Knee disarticulation amputations (with or without indication of surgical technique)
Outcome measures	<p>At least one of the following outcomes measured:</p> <ol style="list-style-type: none"> <li>1. Quality of stump (healing, revision, reamputation)</li> <li>2. Functional outcomes</li> <li>3. Prosthetic ambulation</li> <li>4. Gait biomechanics</li> </ol>

## Results

### Quality Appraisal

SIGN50 Grade of Recommendation<sup>2</sup>: C

17 studies were identified for inclusion in this review. The paucity of controlled trials with 94% of studies having a moderate to high risk of bias led to a low grade of evidence.

### Quality of Stump

12 studies reported on the quality of stump as shown in Table 2. Healing rates are comparable to trans-femoral levels of other studies. However, there are risks of reamputations if the method of amputation level selection is inappropriate. The key is to have ancillary physiological tests to supplement clinical judgments during selection.

**Table 2. Summary of results for quality of stump in KD**

Bibliographic Citation	Technique	No. of KD amputations	Primary Healing	Delayed Healing/Revision	Reamputation
Ayoub et al. (1993)	Anterior Flap	35	88%	9%	3%
Met et al. (2008)	Sagittal Flaps	39	-	26%	21%
Moran et al. (1990)	Sagittal Flaps	106	71%	8%	13%
Ten Duis et al. (2009)	Sagittal Flaps	89	71%	13%	12%
Kock et al. (2004)	Posterior Flap	69	80%	8%	12%
Cull et al. (2001)	Mazet Hennessy	10	60%	20%	20%
Morse et al. (2008)	Mazet Hennessy	50	81%	0%	19%
Campbell et al. (1994)	Gritti-Stokes	8	-	13%	13%
Jackson et al. (2012)	Gritti-Stokes*	14	79%	21%	0%
Nellis and Van De Water (2002)	Gritti-Stokes**	61	100%	0%	0%
Yusuf et al. (1997)	Gritti-Stokes	144	-	-	6.3%
Witsø et al. (2010)	-	84	-	-	18%

\*With trimmed lateral condyles; \*\*Without bevel

### Functional Outcomes

Four studies reported on functional outcomes, which were poorer with more proximal amputations. Trans-femoral patients had poorer maintenance of preoperative independent status than KD patients, however results were only from a 1-year follow-up period.

### Prosthetic Ambulation

Nine studies reported on prosthetic ambulation as shown in Table 3. Ambulation rates vary largely across studies, however most patients had limited preoperative mobility and it would be more accurate to indicate the maintenance of ambulatory status. There was a lack of validated mobility scales, and studies were retrospective with minimal multi-disciplinary involvement in the research teams.

**Table 3. Summary of results for prosthetic ambulation in KD**

Bibliographic Citation	Technique	Outcome Measure	Mean Follow-up	Prosthetic Ambulation
Met et al. (2008)	Sagittal Flap	SIGAM* mobility grades	≤1 year	31%
Moran et al. (1990)	Sagittal Flap	None (descriptive)	≤1 year	53%
Kock et al. (2004)	Posterior Flap	None (descriptive)	≤1 year 2 years 9 years	58% 53% 75%
Cull et al. (2001)	Mazet Hennessy	None (descriptive)	2 years	70%
Morse et al. (2008)	Mazet Hennessy	Survey	3years 5years	56% 41%
Jackson et al. (2012)	Gritti-Stokes**	Survey	“Long-term”	36%
Siriwardena and Bertrand (1991)	Gritti-Stokes	Walking Ability Index (WAI)	≤1year	Not applicable
Yusuf et al. (1997)	Gritti-Stokes	Stanmore mobility grades	≤1year 2 years	21% 13%
Taylor et al. (2005)	-	None (descriptive)	≤1 year	62%

\*SIGAM=Special Interest Group in Amputee Medicine;

\*\*with trimmed lateral condyles

### *Gait Biomechanics*

Two studies reported on gait biomechanics and walking capacity decreased with more proximal amputation levels. One study indicated that KD provided greater stability than trans-tibial levels for dysvascular patients, but the evidence was insubstantial.

### *Overview of Surgical Techniques*

The anterior flap is unsuitable for dysvascular patients. Theoretically, the posterior flap allows better vascularisation and padding than sagittal flaps, but there were no direct comparisons between both techniques. The Mazet technique is potentially propitious in the quality of stump and prosthetic ambulation, but more robust study designs are required to justify that the technique is suitable for dysvascular patients. Gritti-Stokes amputations had low reamputation rates, but controversial ambulation rates, and may be suitable for non-ambulatory patients.

### **Recommendations**

The overall strength of evidence of current literature is low and further credible research is required to determine if a greater proportion of KDs can be justified among dysvascular amputees. The authors recommend future research to be of prospective KD studies among dysvascular patients with comparisons to different amputation levels and the inclusion of results from long-term follow-up periods. Variables have to be fully identified and accounted for in multivariate analyses as rehabilitation outcomes are multifactorial. If prosthetic ambulation is measured, the involvement of prosthetists and physiotherapists with the use of validated mobility scales are necessary.

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Title: **Phantom Limb Pain (PLP) in lower limb amputees: the first steps to confirm the pain mechanism – provisional results**

Presenter: **C Richardson, Lecturer, Dr**

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### **Background:**

Cortical reorganisations are implicated in the development of PLP; however all of the evidence arises from studies on upper limb amputees. Following amputation, the arm area of the sensory homunculus is taken over by the adjacent areas. Lower limb amputation is expected to be the same and anecdotal evidence indicates that patients complain of exacerbation of PLP following sexual activity/defecation.

### **Aims:**

To ascertain what stimulates post amputation phantom phenomena in a group of lower limb amputees.

### **Objectives:**

To identify areas of the body which stimulate or exacerbate phantom phenomena in lower limb amputees? To identify biopsychosocial activities which produce or exacerbate phantom phenomena in lower limb amputees?

### **Methods:**

This was an interview study using structured questionnaires. Participants were asked what sets off or exacerbates PLP, focusing on expected touch and activity.

### **Population:**

Lower limb amputees from a regional Disablement Services Centre in the North West of England

### **Results:**

122 participants completed the study (130 limb amputations). Seventeen percent stated that touching the stump, perineum or genitals could stimulate PLP. Twenty-two percent stated that activities related to the implicated areas (i.e. defecation) could stimulate PLP. Overall 47 (36%) of the sample showed a referral pattern in the expected areas.

### **Conclusions:**

The minority of lower limb amputees show external signs of cortical reorganisation into the adjacent sensory areas. As the literature is also unclear about how many upper limb amputees show external signs of reorganisation, the role of reorganisations in the generation and propagation of PLP needs to be questioned.

Title: **Military Surgical Stump Revision: The East Grinstead Experience**

Presenter: **Major J A Jeevaratnam,  
Registrar in Plastic Surgery,  
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We present a consecutive series of 48 military amputees, with 78 amputation stumps, managed at the Queen Victoria Hospital in East Grinstead over the 5 year period 2009-2013. These 78 stumps comprised 45 trans-femoral, 31 trans-tibial, 1 upper limb and 1 through-knee. The majority of patients were male, with 1 female patient.

Conditions such as heterotopic ossification present in 44% of trans-femoral military amputees, as against 16% of trans-tibial amputees. Neuromas though frequent in both groups, are more common in the trans-tibial amputee.

We discuss how our experience has developed over the last 5 years. The management of these patients has required a full multidisciplinary approach. Post-operative complications are common and combining traditional principles, such as delayed primary suture, with more modern techniques, such as topical negative pressure dressings, together with the development of strict peri-operative protocols, have led to improved outcomes.

Title: **Holistic management of multi-limb amputees**

Presenters: **The Roehampton Team, Queen Mary's Hospital, Roehampton**

The complexities of planning the holistic management of the multi-limb amputee are challenging with many factors to consider

When to start

- What setting is best – Inpatient or Outpatient
- What to start first – Upper limbs or Lower limbs
- What are the priorities – Patient's and Clinician's
- What are the immediate goals – Patient's and Clinician's
- How are we going to achieve them

During the presentation we plan to outline, using examples from clinical caseload, the types of strategies we have used at Roehampton to address the above issues and provide some of the “solutions” to problems that we have applied in clinical practice.

We will consider

- the early management and non-prosthetic solutions to problems
- early therapy input
- Prosthetic considerations and protocols
- Therapy progression
- Current equipment and technology and its uses
- Function and planning for discharge

Title: **Rehabilitation of multi-limb amputees and transitioning from military to civilian life”**

Presenters: **Ms Kate Sherman, Clinical Lead Physiotherapist, DMRC Headley Court, Surrey**  
**Mrs Allyson Ballard – Complex Trauma OT, DMRC Headley Court, Surrey**  
**Mr Matt Webb**

This presentation will cover military rehabilitation of complex traumatic injuries and the importance of the inter-disciplinary team. We will discuss differences between military and civilian life that may not automatically be considered, especially with regard to the transition process out of the military.

We will also address the integration of sport and social activities into the rehabilitation process, the use of old, new and emerging technologies and discuss potential future biopsychosocial considerations.

It may be noted that the concept we work to is that recommended as the definition of rehabilitation by the WHO in 1969: “The combined and co-ordinated use of medical, social, educational and vocational measures for training or re-training the individual to the highest possible level of functional ability.

Title: **A Survey on Prosthetic Abandonment in Upper and Lower Limb Amputees**

Presenter: **Dr R Pabbineedi**

Contact: Disablement Services Centre  
Address: University Hospital of South Manchester NHS Foundation Trust

Other  
Authors: Dr R C Bose & Professor J Kulkarni

### **Aims / Objectives:**

Provision of prosthesis to an amputee may not be beneficial in the longer term in some cases. It involves usage of significant amount of resources, both in terms of money and valuable time spent by professionals. Early abandonment of prosthesis translates into wastage of these resources. Our aim is to review the incidence of prosthetic abandonment in upper and lower limb amputees and to identify the risk factors.

### **Method:**

Retrospective study of case notes of patients who abandoned prostheses from April 2012 to March 2013, at Disablement services centre in Manchester.

### **Results:**

A total of 333(81%) lower limb prostheses were provided when compared to 78 (19%) upper limb prostheses. The number of patients who abandoned prostheses were 51 (32 males and 19 females). 46 were lower limb amputees and 5 were upper limb amputees. 19 patients abandoned the usage in <1 year. Reasons for abandonment were: medical (33), functional (5), personal (4), cognition (5) and unknown (3).

### **Conclusions:**

In our survey, we found about 14 % abandonment in lower limb amputees and 5% in upper limb amputees. Early abandonment was associated with trans-femoral amputees, bilateral lower limb amputees, patients with multiple medical problems, predicted SIGAM grade of C or less, poor motivation and cognitive impairment. In our opinion, it would be beneficial to maintain a yearly register for limb abandonment and also an anonymised questionnaire could be sent out to find the true incidence of non-usage.



**Title:** **Quality of Life and Factors Associated with Successful C-Leg Use**

**Presenter:** **Parisa Norton, Assistant Psychologist, Belfast Health and Social Care Trust**

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David Gow, Head of SMART Services, NHS Lothian.  
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Patricia Humphreys, Physiotherapist, Musgrave Park Hospital, Belfast Health and Social Care Trust.  
Carolyn Wilson, Physiotherapist, Musgrave Park Hospital, Belfast Health and Social Care Trust.

The C-Leg prosthesis was introduced in 1997 to offer people with a transfemoral amputation enhanced rehabilitation opportunities, through its design to adapt to each individual's gait. The C-Leg's reduced metabolic cost, gait smoothness, symmetry and speed adaptability are among its noteworthy features. However as the C-Leg is more expensive than earlier non-microprocessor-controlled (NMC) prosthetic knee joints, the potential benefits need to be weighed against their increased costs. Identifying those who are most likely to benefit most from expensive advanced prosthetic devices will become increasingly important in prosthetic prescription (Schaffalitzky et al, 2012). Successful use of a prosthetic device should be evaluated by the extent to which their use is associated with improved quality of life for their users (Gallagher et al, 2008). Our aim was to identify factors associated with quality of life among C-Leg users. .

Eighteen patients, seventeen males and one female, average age of 51.7 of the Regional Disablement Services, Musgrave Park Hospital Belfast, completed a battery of questionnaires, which included the Trinity Amputation and Prosthetic Scales, Coping Strategy Indicator, The General Health Questionnaire, Cognitive Failures Questionnaire, Amputee Mobility Predictor Questionnaire and Amputee Body Image-Revised Scale in addition to physical and prosthetic measures. We used descriptive statistics, bivariate and multivariate analysis, to explore relationships between variables. Recorded semi-structured interviews with 7 clients were transcribed verbatim and analysed using Interpretative Phenomenological Analysis (IPA), in order to identify salient themes relevant to participant's experience of using their C-Leg. The State of the Art Group, NHS Scotland, provided funding

Psychometric analysis indicated a high level of overall satisfaction with the aesthetic and functional aspects of users' C-Legs and had high scores on quality of life related measures relative to those reported in the literature for users of other types of prosthetic devices. Five themes emerged relating to users' experience of C-legs: improved stability in gait-motion; better quality-of-life; the need for improvement in sockets and reduced reliance on recharging; acceptability being dependant on individual characteristics; and recommendations for the C-leg.

While our results provide support for the C-leg contributing to the quality of life of its users, our modest sample size, lack of a direct comparison group and the cross-sectional design limit the strength of our conclusions. These considerations and other aspects of our results point to the need for a larger-scale study in this area.

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## The OETT Lecture 2014

Title: **'Improving the Evidence Base for the Orthotic Management of Lower Limb in Neurological Conditions'**

Presenter: **Karyn Ross BSc (Hons), MBAPO, MISPO, FHEA**  
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As healthcare professionals working in the area of management of the lower limb in neurological conditions, it is encouraging to note that there is growing interest and an expanding body of research investigating orthotic interventions, particularly the use of ankle-foot orthoses (AFOs) for cerebral palsy (CP) and stroke.

There is an increasing need for Evidence Based Practice (EBP) to inform clinical decision making. EBP is reliant on a clinician's training and experience combined with an understanding and use of the evidence established through scientific research [1]. The expanding body of knowledge on the efficacy of orthotic interventions has the potential to both impact on further research and, importantly, clinical practice.

However this can only happen if studies are well designed with robust testing protocols and appropriate outcomes measures, and if they report on homogeneous patient groups, providing explicit details on participants and interventions. While there is some evidence to support the use of lower limb orthoses following stroke and in the management of children with CP, literature reviews carried out in the areas of cerebral palsy [2-5] and stroke [6, 7] have identified a lack of important detail in previously published research.

If an enhanced level of detail can be considered and reported in future studies, synthesis of results across studies will contribute to an improved evidence base. This will improve the generation of prescription and clinical guidelines which will facilitate enhanced service provision, clinical decision making and the prescription of more appropriate orthoses.

Many clinicians face barriers to becoming more active in research, however there are a numbers of ways in which the National Health Service and industry can engage with Higher Education Institutions to expedite the research process. Effective partnerships and collaborations will facilitate the process of establishing quality research and an evidence base to inform clinical practice.

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Title: **A survey of AFO use, physical and psychological wellbeing in NHS Greater Glasgow & Clyde**

Presenter: **Christine McMonagle**

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### **Aims**

AFOs are used to manage mobility disabilities caused by a wide range of conditions such as stroke, cerebral palsy, multiple sclerosis, and poliomyelitis. Evidence for use of AFOs follows a traditional biomedical approach by measuring specific changes in activity which can be measured in a gait laboratory. While such studies are useful in building an evidence base, they do not provide any information about patients' use of AFOs, or the extent to which AFOs are associated with physical, psychological and social well-being. This study investigated differences in physical, psychological and social well-being between participants using ankle-foot orthoses (AFOs) as recommended, participants who did not use AFOs as recommended, and participants who did not know recommendations for use.

### **Method**

A sample of 157 adults who had been fitted with an AFO by NHS Greater Glasgow and Clyde, Scotland in 2010-2012 completed a postal questionnaire. The International Classification of Functioning Disability and Health (ICF)(1) framework was used to identify outcome measures. Body function and structure, activity and participation were measured using sub scales from the RAND 36-Item Health Survey 1.0, Hospital Anxiety and Depression Scale (HADS) and Positive and Negative Affect Scale (PANAS).

### **Results**

Forty one per cent of the participants ( $n = 64$ ) reported that they used their AFO as recommended; 32% ( $n=51$ ) reported that they did not use their AFO as recommended; and 27% ( $n=42$ ) did not know the recommendations for use. There were no significant differences in demographic or clinical characteristics between these 3 groups. ANOVAs were used to test differences in the ICF measures between groups. Planned comparisons using between subject t-tests showed that participants using AFOs as recommended had higher activity levels, measured by higher physical functioning ( $p=0.005$ ) and lower role-limitations due to emotional problems ( $p= 0.001$ ); and lower levels of impairment, measured by higher energy levels ( $p=0.005$ ) and lower levels of anxiety ( $p=0.003$ ), compared to people not using AFOs as recommended.

### **Conclusion**

The ICF allowed identification of outcome measures to determine potential physical and psychological benefits of AFO use. People using AFOs as recommended had higher levels of physical and psychological well-being than people not using as recommended. Further investigation is required to understand the relationship between psychological variables and AFO use. This may allow development of interventions to ensure appropriate use. Additionally, health professionals should give consideration as to how information, regarding wearing instructions and use of AFOs is provided to people who are prescribed AFOs.

### **References**

1. World Health Organisation International Classification of Functioning, Disability and Health (ICF) Geneva WHO 2001.

Title: **The use of KAFOs for management of Inclusion Body Myositis (IBM)**

Presenter: **Paul Charlton MSc SROrt. Senior Orthotist. Peacocks Medical Group**

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The aim of this paper is to highlight the problems associated with any orthotic intervention in this debilitating condition and the considerable benefits if successful. Beginning with a description of the disease and resulting changes in biomechanical demands imposed. The presentation will then show by means of a case study the need to balance intervention whilst allowing other necessary compensations to optimize function.

Often the use of KAFOs with gross global weakness is discarded as many consider weight and impact on function to be too great. The presentation will consider how assessment and intervention may be introduced to these patients as well as biomechanical needs, careful orthotic design and material selection.

Outcomes include biomechanical changes from gait analysis, pain score, medication change and interview.

This presentation raises the need to consider the psychological aspect of intervention as well as ethical considerations. The paper also questions how such help can be made more readily accessible to those who may benefit. Whilst the presentation is specific to IBM; the principles could be extrapolated to any condition resulting in global weakness.

Title: **KAFO Fabrication: Tips & Tricks**

Presenters: David Buchanan, Andy Dewsbury & Tim Cooney

Composite fibre technology is a rapidly developing field of engineering that has influenced the design of products and machines in the modern world. How can the same materials that help Formula 1 teams win races and stop bullets penetrating vests, support Orthotic Science? This presentation introduces modern composite technology and uses an evidence base to discuss how these materials can influence orthotic prescription and improve outcomes for users.



Title: **Clinically applicable outcome measures to evaluate AFOs in post-stroke hemiplegia**

Presenter: **Joshua Young**, Orthotist, Queen Mary's Hospital, Roehampton, London

Outcome measures are the currency of modern healthcare. Within stroke rehabilitation there is increasing pressure to use standardised outcome measures to evaluate the effects of treatment. An integral part of evaluating clinical orthotic practice is to objectively assess the intervention and measure it against a set of intended outcomes to determine its effectiveness. This presentation focuses on the approach taken by the orthotic service at Queen Mary's Hospital, Roehampton. Preliminary results of a study are presented, using clinically applicable outcome measures to evaluate the effect of Ankle Foot Orthoses (AFOs) on mobility, confidence and pain. Statistically and clinically significant changes are reported. The increased use of outcome measures by other orthotic clinics is encouraged, and the importance of AFO design, tuning and team working is considered.

Title: **Managing combat amputees: prosthetic experience**

Presenter: **John Fergason**  
Chief of Prosthetics  
Center for the Intrepid  
San Antonio, Texas, USA

Multiple approaches have been developed over the recent decade that gives the Prosthetist additional options when approaching socket design for the lower limb amputation. This presentation will summarize the application of several socket designs that have been applied to patient care in the complex traumatic population. Prosthetic prescription will be presented within the context of a major military medical center incorporating research questions, outcomes measures, and a systematic approach to the complex multi-limb amputation.

## George Murdoch Medal 2014

Title: **Rehabilitation for Amputation and Limb Deficiency – The People, The Process & The Product**

Presenter: **Professor Rajiv S. Hanspal, MBBS, DSc (Hon), FRCP (UK), FRCS (Edin.), FRCS (Eng).**  
Consultant in Rehabilitation Medicine,  
Royal National Orthopaedic Hospital,  
Stanmore, Middlesex, UK.

Rehabilitation following surgical amputations and congenital limb deficiency differs from acute clinical treatment in being an inter-active process where the patient is in the center and has to actively participate in the rehabilitation program. The clinicians, working as a team advise and guide the patient rather than perform an intervention on a passive patient. The 'people' and level of their participation is key; the 'processes' of rehabilitation includes resources available and the 'product' is the result. In this presentation, the author presents his contribution through research to the People, the Process and the Product (outcome) in rehabilitation for limb loss. This includes studies on cognition, Body Image, Anxiety & Depression and some Outcome Measures.

While supporting Evidence Based Guidelines, it is recognized that evidence of Level 1 & 2 (RCT, meta-analysis) is rare in prosthetic rehabilitation, often being unethical or impractical. The best available are non-analytical studies, case reports or series. In these circumstances, expert opinion is important evidence to support clinical practice. Thus Delphi studies were used for guidelines on IceRoss Liners and Water Activity Limbs and BSRM standards.

Return to work is an outcome often overlooked. Prosthetic Rehabilitation needs lifelong maintenance, which should be included in all planning.

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**Professor Rajiv Hanspal** is a Consultant in Rehabilitation Medicine at the Royal National Orthopaedic Hospital at Stanmore, Middlesex. Trained initially in Orthopaedic Surgery and subsequently in Rehabilitation Medicine, he is a fellow of both the Royal College of Surgeons and the Royal College of Physicians and was appointed as Consultant in Rehabilitation Medicine in 1990, specialising in Rehabilitation of Amputees, people with Congenital Limb Deficiency and Prosthetics. He also established a neurological rehabilitation unit and the Regional Environmental Service at the Hillingdon Hospital.

In addition to his clinical commitments in the NHS, he has been the President of the British Society for Rehabilitation and served on several committees for the Department of Health and the NHS. He founded the Amputee Medical Rehabilitation Society and the Special Interest Group for Electronic Assistive Equipment. Currently, he chairs the Clinical Reference Group for Complex Disability Equipment to advise the NHS England on Specialist Commissioning (to include Prosthetics, Orthotics, Assistive Technology and specialist Wheelchairs). He has been extensively involved in Training & Education. He developed the Annual Course for Amputee & Prosthetic Rehabilitation now in its 15<sup>th</sup> year. He is involved in Clinical Research and has over 30 publications.

Professor Hanspal has been a member of the ISPO in UK for over 25 years and been Chairman of the UK NMS he was responsible for several initiatives. Subsequently he has served on the Internal Committee, the Protocol Committee, an elected member and Honorary Secretary of the International Executive Board of ISPO. Currently he is the President-Elect of the International Executive Board of the ISPO International.

In 2012, he was awarded the degree of Doctor of Science (ad hominum) for Contribution to Medicine.

Title: **Comparison of the High- Fidelity Interface and a traditional interface using subjective and functional outcome measures: A Case Study**

Presenter: **Randall Alley, BSc, CP**

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**STUDY DESIGN:** This case study reports on an assessment of subjective, physical examination, functional measures, and gait using the Gait Rite mat to measure effect of the High-Fidelity™ Interface (HiFi) compared to a traditional socket design.

**BACKGROUND:** There exists little research regarding control of the femur within the interface. Multiple measures are ideal for determining patient outcomes. This case study is the initial data collection of a planned larger study of the impact of the High- Fidelity Interface on control of the prosthesis, patient subjective and objective function.

**METHODS:** A series of subjective and functional measures were administered by a physical therapist before and immediately after fitting with the HiFi Interface on a subject with a traditional socket and eight years post traumatic transfemoral amputation. For all functional measures, three timed tests were administered and the average was recorded. The researchers intend to gather another set of data at 3-6 months post fitting.

**RESULTS:** Pain change as measured by The Visual Analog Scale for Pain: Pre-test (0/10), Post-test (1/10). Significant improvement in reported socket comfort as measured by The Socket Comfort Scale: Pre-test (3/10), Post-test (7/10). No significant change in self efficacy (no change anticipated, as this was a measure in self-reliance) as measured by the Generalized Self Efficacy Scale: Pre-test (29), Post-test (30). Significant reduction in Activities- Specific Balance Confidence Score to within one point of no fall risk: Pre-test (41.25), Post-test (66.25). There was a 20% improvement in quality of life score as measured by the Patient Evaluation Questionnaire (PEQ-12): Pre-test (21), Post-test (33). There was a 26% reduction in self-reported disability as measured by the WOMAC: Pre-test (62.5%), Post-test (36.5%).

There was an 8.3% change in the mean score of the Four Square Step test. A 49.7% change in the Timed up and Go mean score was measured. There was a 69.4% change in the L-test mean score. The Pre-test Amputee Mobility Predictor (AMP) was recorded as 32, which is correlated to a K2 ambulator. The Post-test AMP was recorded as 41, which correlates to a K3 ambulator. The Gait Rite data was normalized over 25 steps, and the results are as follows: Gait velocity: Pre-test (1.3 m/sec), Post-test (1.2 m/sec). Cadence: Pre-test (108.1 steps/minute), Post-test (104.2 steps/minute). Step Length: Pre-test (Right 71.57 cm, Left 70.86cm), Post-test (Right 68.45, Left 72.48). Stance Time: Pre-test (Right 0.734", Left 0.622" 85% of Right), Post-test (Right 0.758", Left 0.681" 89% of Right). Swing Time: Pre-test (Right 0.365" 75% of Left, Left 0.486"), Post-test (Right 0.392" 82% of Left, Left 0.480"). FAP Score: Pre-test (95/100), Post-test (96/100)

**CONCLUSIONS:** There were no statistically significant changes in gait parameters with the HiFi Interface. However, there were improvements in quality of life and perceived function. All objective functional measures showed significant improvement with the HiFi Interface. Another Post-test after 3-6 months of wear time is recommended to better evaluate the effect of the HiFi Interface.

Title: **Influence of stump/socket relative movement on gait analysis for above knee amputees – A case study**

Presenter: **Jinghua Tang, PhD Student, Mr**

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### **Introduction**

Conventional gait analysis models, marker systems and inverse dynamics are based around intact skeletal structures and rigid linked segments analysis. However in reality for amputee gait analysis the socket interface is in effect an additional joint. Motion artifacts at this 'socket joint' may adversely affect the accuracy of the results. Stump-socket relative movements have been experimentally observed to reach values of up to 151 mm for fast stop and 19 mm for step down; skin-to-skin displacements from skin marker pairs reached value of up to 10 mm for step down and 24 mm for fast stop.<sup>1</sup> In this case study work we sought to investigate way to quantify the degree of 'socket joint' motions which may exist. This was done through a combination of gait analysis marker modelling analysis and finite element analysis (FEA).

### **Materials and Method**

Gait lab measurements of a knee disarticulation patient during slow ambulation was recorded and subsequently used as input for inverse dynamics analysis. The resultant loads at the knee joint was used as inputs to predict the relative movement between stump and the socket using FEA. Socket angle was estimated using hip joint marker and socket cluster in gait analysis. Stump angle was computed using femoral epicondyle point and hip joint data extracted from finite element package. The stump angle was also computed in a way using hip joint marker and extra markers placed on lateral side of residual, just above the socket. FEA process was repeated for different stump tissue properties.

### **Results and Discussion**

Differences between thigh and socket angle in an approximate range of 2-5 degrees were observed in stance phase for slow walking. Comparison of models also showed relative movement of the stump as in relation to the corresponding socket angle. The FEA analysis showed similar trends and further suggests that the degree of socket joint motion is influenced by the residuum tissue mechanical properties.

### **Conclusion**

These pilot results show that in some cases of amputee gait analysis specific consideration of the socket joint motion may be warranted. Further work is required to quantify theses effects in larger groups of amputees along with the development of alternative modelling and gait analysis approaches. Once quantified the degree of socket joint motion may also offer insight into the quality of socket fit and limb control.

### **Bibliography**

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Title: **The effect of a two-dimensional (2-D) motion analysis system on the reliability of the Prosthetic Observational Gait Score (POGS)**

Presenter: **Dr Anthony McGarry**, Prosthetist/Orthotist, Teaching Fellow  
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**Study design:** An experimental pilot study was conducted to test reliability and was designed to facilitate comparison with a previous study: 'Repeatability of a new prosthetic observational gait score for unilateral lower limb amputees' (Hillman et al, 2010).<sup>(1)</sup> Videos of 8 unilateral lower limb amputees were observed by three experienced prosthetists on two separate occasions, 7-10 days apart.

**Background:** Gait analysis is a fundamental tool used to assess a patient's ability or potential throughout the rehabilitation process post-lower limb amputation. A prosthetist along with other members of the multi-disciplinary team (MDT) usually analyse the patient's gait in order to improve gait during rehabilitation.

Pure observational gait analysis (OGA) is the primary method of qualitative GA between physiotherapists and prosthetists worldwide although it may be considered to be an unreliable clinical skill. Such unreliability may compromise a consistent level of care throughout the professional field. It has therefore been recommended that OGA is performed alongside simple measurement devices and biomechanical analysis. Studies suggest the use of video analysis may improve reliability of OGA.

Hillman et al. (2010)<sup>(1)</sup> assessed repeatability of the Prosthetic Observational Gait Score (POGS), designed for those with a unilateral lower limb amputation. The score established good intra-observer repeatability; however, at best moderate inter-observer repeatability. Since publication, the score has been incorporated for use with a commercially available "D analysis system, Siliconcoach™".

**Objectives:** As the use of a quantitative observational gait analysis method has been sought after in clinical prosthetics, it is relevant to investigate whether the reliability of POGS can be improved. This project aims to assess the effect 2D video analysis software has on the POGS intra-observer and inter-observer reliability.

**Methods:** Videos were observed in a randomly selected order. The video analysis software, Siliconcoach™ was chosen owing to its specificity to prosthetic and orthotics. The analyses were documented in accordance to POGS, which then underwent statistical analysis. Observers assessed videos twice in randomly selected orders to facilitate calculation of intra-observer reliability. This allowed calculation of inter-observer reliability. Statistical tests used were percentage agreement, intra and inter-class correlation coefficients (ICC). The significance level was set at  $P < 0.05$ , with reliability ICC 0.7-0.9.

**Results:** Results demonstrated good intra-observer reliability for total POGS scores with observer 1 achieving a moderate ICC of 0.63 and wide confidence interval (CI=-0.11-0.92), up to observer 3 achieving an excellent ICC score of 0.96 and narrow CI (0.84, 0.99). The overall ICC between observers was good, with a score of 0.69 and wide CI (0.31, 0.92). All total scores were statistically significant ( $P < 0.05$ ). The percentage agreement ranged from 39% for 'knee flexion in terminal stance and pre-swing' to 92% for 'foot rotation at initial contact'.

**Conclusions:** The results suggest improved inter- and intra-observer reliability when the auxiliary 2D gait instrumentation is used alongside the POGS. As this is a pilot study however, statistical testing must be interpreted with caution due to the small observer participants (n=3) and video subject participants (n=8).

## References

1. Repeatability of a new observational gait score for unilateral lower limb amputees. Hillman SL, McCurrach E, Richardson A, Herman J, McGarry A, Robb J. s.l.: Elsevier, 2010, Vol. 32.
2. The use of quantitative gait analysis for the evaluation of prosthetic walking performance. Gard, SA. s.l. : Journal of Prosthetics and Orthotics, 2006, Vol. 18, pp. 93-104.



Title: **Enhancing measurement of prosthetic outcomes: new tools to quantify the patient's experience**

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Prosthetists and other health care providers are increasingly encouraged, expected, or required to assess and document patient outcomes using standardized outcome measures. Patient reported outcomes (PROs) are well suited to measuring important clinical outcomes from the patient's perspective. However, many PROs developed for use with prosthetic users have suboptimal psychometric properties (eg floor and ceiling effects, long administration times) that make them less suitable or desirable for use in clinical settings. To address these limitations, researchers at the University of Washington, Seattle, USA, have developed a novel PRO to measure lower limb prosthetic mobility using modern measurement methodology and instrument development standards. The Prosthetic Limb Users Survey of Mobility (PLUS-M) is a self-report instrument for measuring mobility of adults with lower limb amputation. It has been rigorously developed using modern psychometric methodology and is intended for use in clinical practice and research.

Dr Hafner will present an overview of the 5-year effort to develop, test and validate PLUS-M. He will also share insights into the use of modern PROs in contemporary clinical practices and discuss how measures, like PLUS-M can be used to enhance our understanding of prosthetic technologies, services and outcomes.

Title: **3-directional load sensing system for stump-socket interface**

Presenter: **Piotr Laszczak, PhD student, University of Southampton, MEng**

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Real-time monitoring of both pressure (normal to the surface) and shear (tangential to the surface) stress at stump-socket interface for lower limb amputees has been a long-standing challenge in the prosthetic research field as many interfacial devices have been reported in the past 50 years<sup>1</sup>. However in most cases shear loading has not been measured primarily due to technical difficulties and a lack of availability of suitable sensor technology. This is despite shear loading being a principle contributing mechanism to ischemia/reperfusion tissue injuries which may occur in the stump. The profound need for socket comfort and optimal socket fitting can also not be understated, hence the need to develop clinically practical measurement and assessment tools.

This paper presents a novel capacitive sensing system which can be used to obtain dynamic and 3-directional load information at specified locations at the stump-socket interface. The developed sensors are flexible and thin. The performance of the sensor system has been extensively characterised in research lab settings followed by pilot walking tests conducted on a trans-femoral patient with sensors placed in three locations: distal end, anterior and posterior walls.

The results suggest a highly repeatable, reliable and linear performance of the sensing system when subject to typical loading conditions within the socket. In particular, the sensor exhibits high resolution of approx. 5kPa for pressure and 2kPa for shear, which matches the state-of-the-art transducers in this field<sup>2</sup>. Very small non-linearity, at the levels of 4.64% and 1.45% for pressure and shear respectively, simplifies necessary signal conditioning. Low level of cross-talk (6.93% full scale output (FSO) for pressure and 6.23% FSO for shear) were found.

In the walking tests, load patterns were found to closely resemble ground reaction force (GRF) profiles, with characteristic double hump. With respect to GRF, timing of the peak loads were within margin of +/- 3% of gait cycle. Both pressure and shear magnitudes were in good agreement with existing literature. The results offered a tantalising initial insight into the dynamic nature of socket loading. Further work is now underway to expand to develop toward a clinically friendly tool for dynamic socket interface assessment with a view to digitizing socket comfort and fit.

1. Sanders JE. Interface mechanics in external prosthetics: review of interface stress measurement techniques. *Med & Biol Eng & Comput* 1995; 33: 509-516.
2. Williams RB, Porter D, Roberts VC, Regan JF. Triaxial force transducer for investigating stresses at the stump/socket interface. *Med & Biol Eng & Comput* 1992; 30: 89-96.

**Title:** Influence of an Integrated Control Approach on Ramp Descent Control Strategies for Transfemoral Gait

**Presenter:** N Stech, Research Engineer, Miss

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### Introduction

Advanced prosthetic knee and foot design has shown benefits such as reduced posteriorly directed centre of pressure displacement and reduced internal stresses (De Asha et al., 2013; Portnoy et al., 2012). In order to develop the technological level even further integrating a knee and a foot under a single controller might be the future pathway.

### Methods

The aim of the study was to correlate the relationship between damping at the knee and the foot, based on the hypothesis that the ankle influences the bending moment used to control knee stability and thus control to fully optimize limb function for situations like ramp descent there needs to be reciprocated knee and ankle joint control resistance changes.

Lower limb kinematics and kinetics of 4 unilateral transfemoral amputees were studied using 3D motion analysis (Codamotion) and Kistler force plate built into a 5° ramp. An integrated control system consisting of an MPC hydraulic ankle-foot and a hybrid MPC knee joint with hydraulic stance and pneumatic swing control combined under a single controller was used.

The test protocol comprised walking up and down an incline of 5° at normal self-selected speed, comparing 2 control methods: 1) integrated knee-ankle joint control and 2) independent and separate knee-ankle control.

### Results and discussion

The measurement showed that damping resistance changes in the foot change the resulting range of movement of the hydraulic ankle and have an influence on the ankle bending moment thus validating part of our hypothesis. The profile and timing of the bending moment especially during mid-stance is highly influenced by the damping resistances; e.g. a higher initial increase of the bending moment after full ground contact occurs for a low plantarflexion (PF) and a high dorsiflexion (DF) setting compared to a medium PF and DF setting. The adaption of the bending moment influences the loading response during stance which directly affects the pressure of the stump-socket interface.

When comparing the two control methods in some instances where joint control was separated it was shown that the magnitude of change to ankle moment used for knee control had the potential to effect the overall stance-swing control; thus the requirement for reciprocated control and the second part of our hypothesis was shown to be valid.

### Conclusion

Our study shows there is a potential need for the knee to know what the ankle is doing and then to adapt its control strategy based on that knowledge. For example the ankle ramp detection functionality can lead to a different knee control strategy. The understanding of the influence of integrated control of two joints in transfemoral gait might play a key role in future prosthetic development.

### References

1. De Asha AR, et al. *Clin Biomech (Bristol Avon)* 2013; 28 (2): 218-224
- Portnoy S, et al. *Gait & Posture* 2012; 35(1): 121-125

Title: **A New Approach for Biomechanical Analysis of Prosthetic Foot Function**

Presenter: **Gillian Conway – Team Lead Prosthetist, Headley Court, Blatchford**

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**Aim:** At present gait analysis modelling of prosthetic feet have a number of short comings. One among them, includes for example, an inability to separate and then quantify individual design elements of the foot and then relate these to clinical function. The aim of this study was to explore and develop a new gait analysis model and method of analysing prosthetic foot function which offers specific characterisation of individual design elements and contributions within the gait cycle.

**Method:** A 3D motion capture system (Codamotion motion, CX1) was used to collect marker and force plate data on Echelon, Echelon VT and Esprit Feet. The new marker placement model was developed to identify the individual functional/structures of each foot, these included the toe and heel springs, chassis, the hydraulic unit and the VT unit. Data was recorded for flat ground walking and ascending and descending slopes, as well as assistive and break settings when using a hydraulic ankle. ODIN analysis software and post processing of the data was performed using excel.

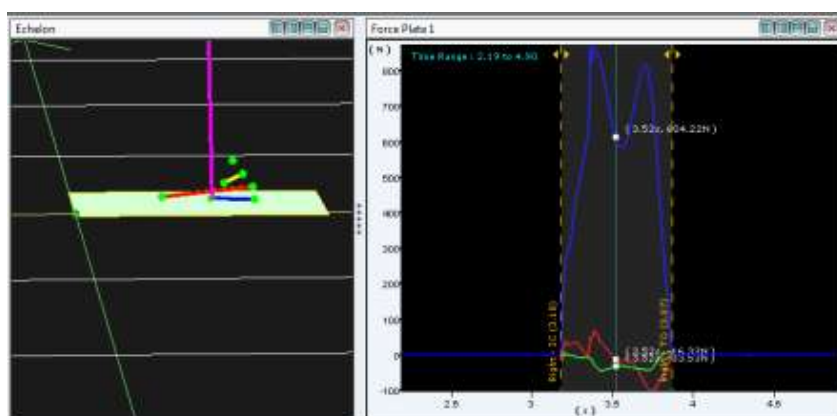


Figure 1. Marker and force Data for Echelon foot

**Results:** Through using the data collected we were able to find ways of modelling the different aspects of each foot throughout the gait cycle. These included spring deflection, hydraulic ankle motion and vertical displacement of the shock unit. For each feature looked at we were able to determine and identify the amount of motion, the rate it occurs and at what points in the gait cycle. Thus for the first time we are able to quantify the mechanical contributions of each of mechanical elements of the foot.

The Results showed that the magnitudes and timing of the spring/hydraulic elements could be influenced by damping setting. For example: On the Echelon foot the magnitude of heel spring deflection increased by 12% when on assist hydraulic settings for flat ground walking. This reflects what is currently observed with the Elan foot assist mode, that by increasing the pf resistance of the hydraulic ankle more force can be transferred to the heel springs resulting in increased energy storing and release from the heel springs. Alternatively when using the echelon foot for descending a slope the duration of the stance phase of gait increased by 6% when on the break settings compared to the normal echelon foot setting. Again quantifying what is currently observed.

**Conclusion:** This system was able to identify the key features of each prosthetic foot assessed. It also allowed for these features to be quantified both directly and in isolation and when combined. This has demonstrated that this type of analysis has the potential to provide a greater level of objective evidence regarding foot function and crucially set up, which could support clinicians in providing better evidence based practice and guidance to ensure componentry is setup most effectively. The method developed also has the potential to inform future design, development and evaluation of componentry, and provide the means of modelling and simulation of new designs.



**Title:** Development of an in-patient service for lower limb amputees.

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**Aims:** To investigate service provision for lower limb amputees on an acute vascular surgical ward in relation to National standards & guidelines and to develop practice in line with these standards.

**Methods:** A retrospective audit of patients' case notes over a 6 month period was performed measuring outcomes against recommended clinical practice.

The results were presented to the clinical and managerial leads at the Specialised Ability Centre (SAC) and the acute vascular unit (VU) highlighting gaps between theory and practice. Multi-professional collaboration between both sites led to advancements in clinical practice. A repeat audit was performed 2 years later over a similar 6 month period.

**Results:** Multi-professional collaboration led to the provision of a ward based therapy room for the treatment of lower limb amputees. Funding was provided for specialist equipment and a part-time amputee specialist physiotherapist. Weekly visits to the VU by the amputee specialist nurse and ward rounds alternate weeks by the SAC multi-disciplinary team (MDT) were initiated. Ultimately it led to a reduction in length of stay and improvement in all outcomes measured including; stump oedema management, wound assessment, and early mobilisation.

**Conclusion:** Collaboration between the SAC and the VU resulted in the provision of equipment and staffing to meet the needs of lower limb amputees in the immediate post operative period. Regular visits from the MDT have provided earlier specialist rehabilitation and improved outcomes. Delays in discharges still exist in patients who are resident outside of area. Further work is needed to address this.

**References:**

British Society for Rehabilitation Medicine (BSRM 2003); *Amputee and Prosthetic Rehabilitation Standards and Guidelines*.

Available at: [URL:http://www.bsrm.co.uk/ClinicalGuidance/StdAmpProsRehab.pdf](http://www.bsrm.co.uk/ClinicalGuidance/StdAmpProsRehab.pdf)

British Association of Chartered Physiotherapists in Amputee Rehabilitation (BACPAR 2006); *Clinical guidelines for the pre and post operative physiotherapy management of adults with lower limb amputation*.

Available at; URL: <http://bacpar.csp.org.uk/publications/clinical-guidelines-pre-post-operative-physiotherapy-management-adults-lower-limb-amputation>

Title: **New socket technology for upper limb amputees; trans-humeral case studies**

Presenter: **Lynzy Holding, Prosthetist, Mrs**

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**Aims/Objectives:** Traditional upper limb sockets all share certain problems. Patients often raise concerns around the weight and appearance of their prosthesis. Most upper limb sockets simply contain the tissue of the remaining limb without careful consideration of the underlying anatomy. After thoroughly researching some new developments in the USA, in particular the efforts by R. Alley, it was decided to trial a more modern approach to casting, rectification and the manufacture of the trans-humeral socket. The aim of this study is to trial new 'Anatomically Suspending' lightweight sockets used in conjunction with a pin liner for trans-humeral amputees with a view to improving function, comfort and proprioception. The presentation is a case study of two female trans-humeral patients with identical prescriptions (passive/functional above elbow prosthesis with a suspension harness) and similar residual limb shapes. Both patients had reported that their current prescription had affected their mental wellbeing and damaged their self-confidence.

**Methods:** A cast was taken of each patient's residuum over a pin liner using 4 lolly stick type struts. The struts were placed onto the cast in the same plane as the remaining humerus at equal spaces, once the plaster bandage was applied, then reasonable pressure was applied to the struts to compress the tissue until no further movement is possible, this then creates release areas for the remaining soft tissue to move into. These release areas are cut away on the definitive socket.

Rectification is aggressive with particular focus on the bony anatomy and the longitudinal depressions. A series of diagnostic sockets were manufactured to ensure the correct amount of pressure was applied to the residuum and in turn the remaining soft tissue relieved within the socket windows. With the tissue compressed along the shaft of the humerus when a load is later applied it is unable to compress any further, which means the load is transferred immediately with no lost motion between the socket and the patients residual limb, energy expenditure is then also reduced.

**Results:** The final sockets for the two case studies were effective in greatly improving range of motion, proprioceptive feedback and cosmetic appearance. Both patients reported immediately that the arm now felt 'a part of them' it was much more comfortable to wear and more cosmetic, so lifted the patients' self confidence and wellbeing. Case study 1 has since returned to clinic and reported that the arm also seemed to help with phantom pain which she has suffered with for some time. She is much more independent now and no longer relies on her husband to assist in putting the arm on every morning.

**Conclusion:** 'poor socket design will often drive patients to abandon their prosthesis because many patients have an intact hand or arm. The foundation for all prosthetic procedures is a well designed considerate prosthetic socket' (*Lake C. The Evolution of Upper Limb Prosthetic Socket. J Prosthet Orthot 2008;20:85–92.*) The advances made here are presented for consideration by other teams as a possible solution for trans-humeral amputees.

## POSTER ABSTRACTS

Title: **Maduramycosis and Amputation**

Presenter: **Dennis Woodhouse, ST5 Specialty Registrar, Dr**

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Other Authors: Jai Kulkarni, Professor (Supervisor)

### Introduction:

This poster is to describe a rare case of Maduramycosis requiring Amputee Rehabilitation in our service

### Case Description:

A 46 year old unemployed shepherd presented to our service for pre amputation consultation in 2013 following a 20 year history of worsening mobility. He initially presented in 1991 in Mauritania with pain and swelling of his right foot. Sinus formation and Increased Swelling of Foot occurred further to this. He reported a chronic discharge from the foot and had to cease his previous occupation and mobilise with crutches. He sought Asylum in the UK in 2007 and presented to his local orthopaedic service. He was investigated by Plain X Ray and MRI Imaging of the foot and was commenced on itraconazole after biopsy specimens were obtained and the diagnosis of Maduramycosis was confirmed. However despite this treatment in 2012 he had developed gigantism of his right foot associated with multiple sinuses. Following appropriate counseling he elected to undergo a Right Transtibial Amputation which following Rehabilitation improved his mobility to SIGAM Grade E.

Maduramycosis/Mycetoma is a chronic granulomatous disease subcutaneous inflammatory disease caused by either true fungi or filamentous bacteria. It is endemic and neglected disease within tropical and subtropical areas. (1) Its diagnostic triad is of Tumefaction, Extrusion of Coloured Grains and Fistulisation of Abscess. It is managed medically and or surgically following identification. Predictors of amputation include massive disease with massive tissue and bone destruction, uncontrolled secondary bacterial infection and no response to prolonged medical treatment with antifungals. Amputation level should take consideration of the possibility of lymphatic spread (2)

This case illustrates the need for awareness of a condition which although rare in Non Endemic Areas can still present for consideration of Amputation in the UK. As a neglected disease following amputation in endemic areas prosthetic provision is limited

(1) Fahal et al Management of Mycetoma Expert Review Dermatol 5(1), 87-93 (2010)

(2) Zein et al Predictors of Cure Amputation and Follow Up in Mycetoma Trans Roy Soc Trop Med (2012)

Title: **Holistic multi-disciplinary rehabilitation of a multi-limb loss amputee at the Amputee Rehabilitation Unit, Guy's & St Thomas' NHS Foundation Trust.**

**Case Study: Team working through the journey of a patient'**

Author: Jodie Georgiou, Highly Specialist Amputee Physiotherapist  
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**Background:**

The Amputee Rehabilitation Unit (ARU) is a new 12 bed amputee inpatient facility offering intensive rehabilitation in South East London, Guy's & St Thomas' NHS Foundation Trust. This opened in June 2013. The unit promotes cross disciplinary working and holistic patient management. The rehabilitation ethos is echoed throughout the unit from the rehabilitation facilities to the ward.

Patient X's rehabilitation journey will be demonstrated on the poster presentation using clinical photos and description of milestones achieved, timeframes and validated objective outcome measure results whilst demonstrating the input of multi-disciplines (Physiotherapists, Occupational Therapists, Nursing Team, Medical/Pharmacy and Rehabilitation Assistants).

**Introduction:**

Patient X demonstrates how an intensive, multi-disciplinary approach can lead to a rapid increase in functional outcome and improved quality of life in the early stages of rehabilitation.

**Patient Summary:**

Admitted to Kings College Hospital in March 2013 for multi-organ failure, septicaemia and septic shock (unknown origin).

21.5.13 bilateral trans-tibial amputations and left 4<sup>th</sup> and 5<sup>th</sup> digit amputations due to dry gangrene.

Admitted to the ARU on 4.7.14.

Discharged from the ARU on 29.10.14.

Total 16 weeks inpatient rehabilitation.

During this time Mr X also underwent Tendon Release Surgery as a day case 18.9.14.

Function on Admission: Poor sitting balance, nil functional use of left upper limb, hoist transfers with nursing staff, forward / backward transfers with max assist x2 therapists, hypersensitivity and pain bilateral residual lower limbs and upper limbs, bilateral patella tendon and upper limb wounds and reliant on nursing care for all personal care tasks.

Function on Discharge: Mobilising indoors with x1 stick, outdoors with x2 sticks, stairs with x1 rail and x1 stick, steps/curbs with x1/x2 sticks (dependent on height), Sit to stand from 21inch wheelchair height independently, donned prosthesis independently, wash and dress independently and completing basic meal prep.

**Results:**

Admission Outcome Measures:

SIGAM: A

Barthel: 8/20

9 Hole Peg Test Right: 52.84sec

9 Hole peg Test Left: unable

2 Minute Walk Test: Unable

Timed Up and Go: Unable

LCI-5: 0/56

Discharge Outcome Measures:

SIGAM: Db

Barthel: 18/20

9 Hole Peg Test Right: 20.5sec

9 Hole peg Test Left: 1min 32sec

2 Minute Walk Test: 65m x1stick

Timed Up and Go: 22.85sec x1 stick

LCI-5: 39/56

**Summary:**

As a complicated multi-limb loss patient, Mr X demonstrates how intensive multi-disciplinary rehabilitation can improve functional outcome, demonstrated by the use of validated outcome measures.

Title: **Walking speed and Oxygen Consumption of a Unilateral Hip Disarticulation Amputee during Level Walking Using a C-leg vs a Genium**

Presenter: **Lynsey Duff, Prosthetist, Miss**

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### **Background**

With technological advances in prosthetics, more intuitive componentry has been developed that aims to give the user a more natural and energy efficient gait.

It has previously been observed that hip disarticulation amputees use more energy to ambulate than their able-bodied counterparts.

The aim of this investigation is to compare the oxygen consumption and walking speed of a unilateral hip disarticulation amputee walking on level ground with a helix hip joint in conjunction with a C-leg and a Genium.

### **Method**

One unilateral hip disarticulation amputee gave informed consent to participate.

The participant walked for 5 minutes using the C-leg at their self-selected walking speed and oxygen consumption was measured with the last minute used for analysis. The data collection procedure was repeated with the Genium 4 weeks later. The knee unit was the only prescription variable between sessions.

### **Results**

The participant walked at 0.74m/s with the C-leg and 0.80m/s with the Genium. Oxygen consumption was similar with both knee units. The energy cost of walking reduced with the Genium (0.31) in comparison to the C-leg (0.34).

	C-leg	Genium
Walking Speed (m/s)	0.74	0.80
Oxygen Consumption (ml/kg/min)	14.95	14.95
Oxygen Cost (ml/kg/m)	0.34	0.31

Figure 1: Comparison of walking speed, oxygen consumption, oxygen cost in unilateral hip disarticulation patient wearing C-leg or Genium.

### **Conclusions**

The results indicate that the amputee in this study consumed less oxygen when walking at similar speeds to that previously reported. When walking with the Genium, the participant walked faster and used less oxygen in comparison to the C-leg. The participant also preferred walking with the Genium.

Further data collection and a more detailed analysis is ongoing.



**Title: Traumatic Amputation - before and after the advent of Major Trauma Network**

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**Aims:** To examine trends in traumatic amputations over a period of time before and after Regional Trauma Network went live across Greater Manchester in April 2012. Trauma related amputee prevalence is about 6% in the UK, whilst latest Clinical Information Modalities System statistics from Specialised Ability Centre (SAC) Manchester indicates prevalence of 14%.

**Methods:** All individuals admitted to University of South Manchester NHS foundation Trust Hospital (UHSM), which is a Major Trauma Centre (MTC), between Feb 2011 and March 2014, were identified using hospital activity data and submitted TARN (The Trauma Audit and Research Network) data and electronic data-base of SAC.

**Results:** There was minor fluctuation in admission of minor or major extremity amputations during the study period. Total 11 patients with different amputations were admitted to UHSM; 4 before April 2012 and 7 after. The average age of the admitted individuals was 40.64 year with a range between 2 months to 90.9 years. There was clear male sex preponderance with a ration of M: F 10:1. All of the individuals were alive and only one needed intubation and ventilation for airway management. 4 individuals were brought to MTC in Helicopter Ambulance and none suffered from head injury or shock needing specific intervention. Injury Severity Score (ISS) were all 9 except one with ISS 16. 4 patients were transferred from other hospitals including Trauma Unit and 1 individual was reverse transferred to referring hospital. 3 victims had lower limb amputation at trans-tibial level.

8 individual had upper limb amputation with 6 below elbow, 1 above elbow and 1 due to complex upper limb fractures. Before start of Major Trauma Network in April 2012, not all individuals were referred to limb centre within target period. Only one individual out of total cohort received Prosthesis for daily use and one of them is still having complex plastic interventions.

**Conclusion:** The Greater Manchester Major Trauma Network covers the population of 2.8 million approximately. It consists of 3 MTCs, 3 trauma Units, 5 Local Emergency Departments, 1 children's hospital and 1 Ambulance service (Also Air-Ambulance). The data we are submitting is from 1 MTC, UHSM, which has Regional Ortho-Plastic department, Vascular Department and Vascular Radiology Department. Moreover UHSM is the only MTC out of three with Helipad and can accept airlifted patients. Several factors may explain the slight increase in number of traumatic amputee admitted to UHSM MTC, these findings highlight the importance of integrated major trauma service on quality of care for these individuals with effective collaboration between the trauma service and sub-regional limb loss centre at Manchester. Also due to higher numbers of dysvascular amputee and close collaboration between the SAC and the vascular surgical unit lead to provision of equipment and staffing to meet the needs of lower limb amputees in the immediate post operative period. Regular visits from the MDT have provided earlier specialist amputee rehabilitation leading to improved outcomes for patients with amputation of any level. Further work is needed to address other aspects of care amongst this population.

**References:**

1. National Amputee Statistical Database (NASDAB 2007); Available at: [www.limbless-statistics.org](http://www.limbless-statistics.org)

Title: **Using innovative upper limb prosthesis or device to maximise independence and participation in functional activities**

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Prescription of upper limb prosthesis requires collaborative working between the patient and multidisciplinary team. Compliance and successful use of upper limb prosthesis are dependent on cosmesis, socket comfort, functionality and ease of use during activities of daily living.

The team at Bowley Close Regional Rehabilitation Centre, London has worked jointly with patients to develop innovative designs to improve compliance for upper limb prosthetic use. Examples include:

- Bespoke silicone socket for myoelectric prosthetic use which maximises forearm range of movement and improves comfort
- Using bespoke functional devices for participation in leisure, self-care and work/play. Socket comfort and functionality can be improved as flexible materials and functional tools can be integrated with the device.
- Case studies of patients with unilateral and bilateral upper limb loss

It is recommended to consider most appropriate upper limb socket design to increase compliance and motivation for prosthetic use. "Well thought out socket designs and careful consideration of residual limb presentation set the stage for patient success—maximising range of motion, providing stability throughout daily activities, and comfortably distributing the forces exerted on the residual limb during movement and suspension" (Lake, 2008).

In conclusion, it is essential that the team works jointly with patients for goal setting, and maximising upper limb socket comfort and function as "appearance, movement and usefulness of a prosthesis will have a large bearing on patient's satisfaction, use and acceptance or abandonment of the prosthesis" (Ritchie et al, 2011).

#### **References:**

Lake.C (2008) The Evolution of Upper Limb Prosthetic Socket Design. *JPO*, 20(3): 85-92.  
Ritchie S, Wiggins S, Sanford A (2011) Perceptions of cosmesis and function in adults with upper limb prostheses: a systematic literature review. *Prosthetics and Orthotics International*, 35(4): 332-342.

Title: **Strength and conditioning for the Lower Limb amputee**

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#### Aims and objectives

Strength exercises have been shown to give increases in strength of up to 40% in untrained individuals and improvements in performance measures (Garber et al., 2011). At Roehampton, the amputee therapy team felt that we would benefit from a refresher on the topic in order to gain up to date evidence-based knowledge to ensure effective use of strength exercises as part of our treatment.

#### Method

Following the attendance of strength and conditioning course run by APPI (Australian Physiotherapy & Pilates Institute), in-service training was delivered in order to review our current practise and how we could improve this based on up to date recommendations.

#### Summary:

This poster demonstrates changes that we have made following this review based on current evidence.

1. The production of a table with recommendations for sets/ reps based on the most current exercise prescription guidelines.
2. Inclusion of an exercise to work on power during our balance circuit.
3. More focus on prescription of sets/ reps when using P.I.R.P.A.G. exercises in order to work towards the desired goal.
4. An increased focus on multi-joint, functional exercises.
5. The consideration of the neural responses to exercise when planning an exercise program (Hakkinen et al., 1988).

#### Recommendations

In order to monitor the effects of our change of practise, manual muscle testing will be used as an outcome measures to monitor any strength changes. In addition to this, the TUAG (Timed up and go) will be used to measure any changes in functional performance.

#### References

Garber et al. (2011) Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise, *American college of sports medicine*, 43(7), pp1334-1359

Hakkinen et al., 1988, Neuromuscular and hormonal adaptations in athletes to strength training in two years. *Journal of Applied Physiology* 65(6):2406-2412

Title: **London Hand Transplant Team**

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Hand transplantation is the most commonly performed Vascularised Composite Allotransplantation (VCA). It is a developing reconstructive option in upper limb amputations and has been used once in the NHS by Professor Kay in Leeds. The London Hand Transplant Team is a collection of interested parties from hospital across London involving hand surgeons, transplant surgeon, immunologists and hand therapists who aim to establish a hand transplant programme in London.

This poster demonstrates the proposed patient pathway. Pre-operative: the identification of potential patients in clinic, the process of patient selection, screening, education and work up. Peri-operative: The plans for the surgical teams from donor and recipient, strategies for immunosuppression and inpatient care. Post-operative: Hand therapy, immunosuppression, follow up and psychological support.

The process of starting the programme and building the team is demonstrated with the identification of key individuals, hospitals and infrastructure, outlying plans for a simulated practice of the procedure, and the process of applying for NHS approval and funding.

The benefits of a hand transplant must be weighed against the risks of immunosuppression. To be viable the London Hand Transplant Team must be a coherent, safe and effective programme that can deliver the highest quality outcomes for the patient from the very first case.

## EXHIBITION

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