CONTENTS

WELCOME

Dear Colleagues

On behalf of the organising committee I am delighted to extend a very warm welcome to all participants. We have had an unprecedented response in terms of quality paper submissions, delegate registrations and exhibitor representation which is particularly encouraging in this economic climate. Around 14 different countries will be represented which I believe indicates the excellent reputation of previous Trent Symposia for quality and content. For TIPS 2009 the organising committee has been working hard to produce what we believe is a truly exceptional program of quality **Presentations**, **Manufacturers Workshops and Instructional Workshops**.

We have been fortunate in getting both International and UK well distinguished **Guest Speakers** who I am sure will give interesting and stimulating presentations. In order of appearance on the program, many thanks to **John Miguelez USA, Stephanie Lacour UK, Frank Letch UK** and **Kristin Gulick USA.**

Support from exhibitors involved in the field of upper limb prosthetics has been excellent and the **Commercial Exhibition** will add greatly to the overall comprehensive nature of the Symposium. We do recommend that you spend time in the exhibition area. This is your chance to catch up with the world market and make manufacturers and agents aware of the needs of your patients. In addition a number of manufacturers are extending their support in providing some extremely interesting Manufacturers Workshops and I am sure everyone will find a topic of interest and value.

An additional feature of TIPS 2009 will be the **Instructional Workshops** on Wednesday afternoon. Many thanks go to the talented workshop coordinators and speakers who have volunteered their time to provide extremely interesting and stimulating topics. I am sure these workshops will be one of the many highlights of the Symposium.

No gathering of kindred souls is complete unless there is a social side to the event. Apart from the widespread and invaluable personal networking which always takes place, the organising committee has arranged a **Conference Dinner** and **Informal BBQ** for your enjoyment; we are extremely appreciative of Otto Bock Healthcare PLC and Touch Bionics respectively for support for these events. We look forward to seeing you during this less formal aspect of the Symposium.

The organising committee of TIPS welcomes your feedback in order that the future Symposia may continue to improve. Please complete the feedback form with your delegate pack and hand it in at the end of the meeting. Based on your feedback, the organisers and ISPO can plan with rational basis any necessary modifications to the programme and other arrangements which make the Trent International Prosthetic Symposium such an important and enjoyable occasion.

Our thanks go to sponsors Otto Bock Healthcare and Touch Bionics, all exhibitors and speakers for their continued support, ISPO UK NMS for their support and to you for your attendance.

We wish you an interesting and enjoyable three days.

Bill Dykes
Chair
Trent International Prosthetic Symposium 2009

INFORMATION FOR DELEGATES

Symposium Registration & Delegate Information
All delegates must register for the symposium on arrival. The ISPO Registration Desk is located at the main entrance to Burleigh Court Conference Centre and will be open each morning from 0830 hrs. An information point for delegates is also available within the Coffee/Exhibition Area.

Accommodation Registration & Information
Delegates who have booked accommodation at Burleigh Court should ensure they register at the Main Reception adjacent to the ISPO Registration Desk. Bedrooms will be available from 1400 hrs on the day of your arrival. Secure storage facilities for luggage are available adjacent to the Main Reception area.

Breakfast is served in the dining area from 0700 hrs.

The leisure facilities, swimming pool and gym will also be open from 0700 hrs.

Car Parking
Delegates may park in the Burleigh Court Conference Centre car park at no charge. The car park is covered by 24 hr CCTV. Please note that ISPO UK NMS cannot be held responsible for any loss or damage caused to vehicles parked in this or any adjacent area.

Taxis/Public Transport
Information regarding taxis and public transport is available from the Main Reception at the entrance to Burleigh Court Conference Centre.

Lunches & Refreshments
Lunches will be served over two sittings to avoid unnecessary queuing in the buffet/dining area and provide all delegates with an opportunity to visit the Exhibition. Lunch tickets will be included in all delegate packs.

Refreshment stations will be situated throughout the Exhibition/Coffee area.

Social Events: BBQ – Monday 18 May & Conference Dinner – Tuesday 19 May
Entry to both events is by ticket only. All delegates who have pre-ordered tickets should receive them in their delegate pack at the time of registration. If, for any reason, tickets are not included with your pack, please speak to a member of the organising committee at the ISPO Registration Desk.

An informal BBQ, sponsored by Touch Bionics, will be held in the Burleigh Courtyards, weather permitting. Dress code is casual.

Dress code for the Conference dinner, sponsored by Otto Bock Healthcare plc, is smart/casual. A table plan is located at the information point in the Coffee/Exhibition area. Delegates attending the conference dinner should add their name to the table plan by 3.00 pm on Tuesday 19 May.

Manufacturer's Workshops – Tuesday 19 May 2009
Five manufacturers' workshops will run concurrently on Tuesday afternoon, with each workshop running twice to allow delegates the opportunity to attend a maximum of two workshops. Entry is by ticket only. Tickets will be included with your delegate pack. If you have not received your tickets or if you have not registered for workshops and wish to do so, please speak to a member of the organising committee at the ISPO Registration Desk.

Instructional Workshops – Wednesday 20 May 2009
Four instructional workshops will also run concurrently during the afternoon of Wednesday 20 May. Each will be presented twice, allowing delegates the opportunity to attend a maximum of two. Again, entry is by ticket only. Tickets will be included with your delegate pack. If you have not received your tickets or if you have not registered for instructional workshops and wish to do so, please speak to a member of the organising committee at the ISPO Registration Desk.

PROGRAMME

Monday 18 May

0830 – 1000 hrs **Registration & Refreshments**

1000 – 1015 hrs **Welcome** *Bill Dykes, Conference Chair*

1015 – 1045 hrs ***"Upper Extremity Prosthetics: State of the Science"***
Guest Speaker: John Miguelez, Advanced Arm Dynamics, Oregon, USA

1045 – 1200 hrs **Free Paper Session** *Chair: H Sears/R Cooper*

"Towards multi-movement hand prostheses: combining adaptive classification with high precision socket"
M Winkler, OTW Orthopadietechnik Winkler, Minden, Germany (presented by A Boschmann) Paderborn, Germany)
"A voice-controlled prosthesis: test of a vocabulary and development of the prototype"
E Gruppioni, I.N.A.I.L. Prosthesis Centre, Vigorso di Budrio, Italy
"A use of rapid prototyping in prosthetics: wrist powered partial hand with multi-articulate jointed fingers"
A M P Clawson, Institute of Biomedical Engineering, University of New Brunswick, Canada
"Early partial hand patient outcomes utilising prodigits (myoelectric controlled prosthetic digits)
K Lindborg, Touch Bionics, Livingston, UK
"Natural grasping: on the design of voluntary closing hand prostheses"
D H Plettenburg, Delft Institute of Prosthetics & Orthotics, Delft, The Netherlands
"A two degree of freedom powered prosthetic wrist controlled using pattern recognition of forearm EMG"
P Kyberd, Institute of Biomedical Engineering, University of New Brunswick, Canada

1200 – 1345 hrs **Exhibition & Lunch**

1345 – 1415hrs ***"Prosthetic Electronic Skin: How to integrate sensory feedback on conformal artificial skin"***
Guest Speaker: Dr Stephanie Lacour, Cambridge Nanoscience Centre, University of Cambridge

1415 – 1530 hrs **Free Paper Session** *Chair: L Hermansson/M Leong*

"A cross sectional study of amputees at a Sydney amputee clinic"
J Davidson, Prince of Wales Hospital, Sydney, Australia
"The effect that a congenital upper limb deficiency has on a child and his/her parent(s). Does a prosthesis help?
M Punchard, Exeter Mobility Centre, Exeter, UK
"Management of musculo-skeletal symptoms of the contralateral limb in upper limb amputees"
S Sooriakumaran, Roehampton Rehabilitation Centre, London, UK
"Does silicone partial hand prosthesis improve ability to work?"
H Burger, Institute for Rehabilitation, Ljubljana, Republic of Slovenia
"A service evaluation of currently prescribed cosmetic gloves and consequent implementation of Regal gloves for upper limb prostheses"
M Hewitson & A Silitoe, SMART Centre, Astley Ainslie Hospital, Edinburgh, UK
"From activity to participation – a case presentation"
Z Pihlar, Institute for Rehabilitation, Ljubljana, Repulic of Slovenia
"Audit of the outcome of hypnosis as a treatment of Phantom Limb Pain"
M W Li Tyng, Specialist Mobility Rehabilitation Centre, Preston, UK

1530 – 1615 hrs **Exhibition & Refreshments**

1615 – 1730 hrs ***Free Paper Session*** *Chair: R Luff/W Dykes*

"Use of an ITAP implant for prosthetic reconstruction of a transhumeral amputee"
N Kang, Department of Plastic Surgery, Royal Free Hospital NHS Trust, London, UK
"Clinical experience with the first upper limb ITAP recipient"
L Marks & J Rendell, Stanmore Disablement Services Centre, Stanmore, UK
"Prosthetic management of a transhumeral amputee with an ITAP insertion"
N Pretty, Limb Fitting Centre, Royal National Orthopaedic Hospital, Stanmore, UK
"The role of physiotherapy within the management of patients with upper limb loss or absence in a regional rehabilitation centre in the UK"
M J R Cole, Roehampton Rehabilitation Centre, London, UK
"Clinical Gait Analysis of Upper Extremity Amputees"
D R W May, Kings College Hospital Rehabilitation Centre, London, UK

1800 hrs **Exhibition Closes**

1900 hrs **BBQ & Drinks Reception, sponsored by Touch Bionics**

Tuesday 19 May

0800 – 0900 hrs **Registration & Refreshments**

0900 – 0930 hrs ***"Feet First"***
Guest Speaker: Frank Letch, REACH

0930 – 1030 hrs **Free Paper Session** *Chair: K McCrea/J Ronald*

"Elbows and wrist innovations to advance function"
H H Sears, Motion Control Inc., Salt Lake City, Utah, USA
"Doctor, why can't I have an i-Limb?"
S Sooriakumaran, Roehampton Rehabilitation Centre, London, UK
"Properties of goal-directed movements with upper extremity prostheses"
H Bouwsema, Centre for Human Movement Sciences, University of Groningen, The Netherlands
"The assessment of capacity for myoelectric control: development of standardized activities"
H Lindner, Centre for Rehabilitation Research, Orebro, Sweden (presented by L Hermansson)
"Case study illustrating multi-disciplinary team working to achieve powered wheelchair control for a patient with a spinal injury and upper limb amputation"
K Cook, Prosthetic Centre Disablement Services Centre, Southmead Hospital, Bristol, UK
"Home modifications/adaptations"
C Ragno, Center for Arm Amputees, Red Cross Hospital, Stockholm, Sweden

1030 – 1115 hrs **Exhibition & Refreshments**

1115 – 1215 hrs **Free Paper Session** *Chair: Janet Kingston/Paul Steeper*

"Identifying the outcomes of upper prosthetic limb rehabilitation and their predictors: the patients' and rehabilitation professionals' perspective"
S NiMhurchadha, School of Nursing, Dublin City University, Dublin, Ireland
"Creating an informational interactive DVD resource for children with congential limb deficiency and amputations through audit and patient and public involvement (PPI)"
L Kirby, Specialist Mobility Rehabilitation Centre, Preston, UK
"Family picnics with children after upper limb amputation"
D Brezovar, Institute for Rehabilitation, Ljubljana, Republic of Slovenia
"Training with cosmetic prosthesis"
M Nilseryd, Center for Arm Amputees, Red Cross Hospital, Stockholm, Sweden
"Clinical experiences of mirror training"
C Ragno, Center for Arm Amputees, Red Cross Hospital, Stockholm, Sweden
"EX-Center, team approach"
A Stockselius & C Ragno, EX-Centre, Red Cross Hospital, Stockholm, Sweden

1215 – 1415 hrs **Exhibition & Lunch** *(Exhibition closes 1415 hrs)*

1415 – 1445 hrs ***"The Ultimate Challenge"***
Guest Speaker: Kristin Gulick, OTR/L, CHT, Oregon, USA

1445 – 1545 hrs **Manufacturers' Workshops**

(a) Motion Control Inc: *"Advances in elbow, TD and wrists for upper extremity function"*
Presenter: Harold Sears
(b) Otto Bock Healthcare PLC: *"PAULA: Technology for evaluation, fitting and training for upper limb prosthetics"*
Presenters: Martin Werhle & Ken Hurst
(c) RSL Steeper Ltd: *"Achieving goals and satisfying ADL requirements"*
Presenters: John Ronald and Bruce Rattray
(d) Touch Bionics: *"The i-LIMB Hand"*
Presenters: to be confirmed
(e) Polymer Systems Technology Ltd: "Silicone Processing Techniques"
Presenter: Derek Williams-Wynn

1545 – 1600 hrs **Refreshments**

1600 – 1700 hrs **Manufacturers' Workshops**

(e) Motion Control Inc: *"Advances in elbow, TD and wrists for upper extremity function"*
Presenter: Harold Sears
(f) Otto Bock Healthcare PLC: *"PAULA: Technology for evaluation, fitting and training for upper limb prosthetics"*
Presenters: Martin Werhle & Ken Hurst
(g) RSL Steeper Ltd: *"Achieving goals and satisfying ADL requirements"*
Presenters: John Ronald and Bruce Rattray
(h) Touch Bionics: *"The i-LIMB Hand"*
Presenters: to be confirmed
(i) Polymer Systems Technology Ltd: "Silicone Processing Techniques"
Presenter: Derek Williams-Wynn

2000 hrs **Conference Dinner sponsored by Otto Bock Healthcare plc**

Wednesday 20 May

0830 – 0900 hrs **Registration & Refreshments**

0900 – 1000 hrs **Free Paper Session** *Chair: Robin Cooper/ Viv Ibbotson*

"Management of transhumeral amputation and contralateral hemiplegia in a child"
E McGilloway, Roehampton Rehabilitation Centre, London, UK

"Rehabilitation of a patient with bilateral amputation due to epidermolysis bullosa – a case report"
M Burgar, Institute for Rehabilitation, Ljubljana, Republic of Slovenia

"Functioning with a congenital reduction deficiency of the upper extremity: the role of adaptations"
I van Wijk, Rehabilitation Centre De Hoogstraat, Utrecht, The Netherlands

"Custom-made silicone liner prosthesis for congenital infant: a case study"
V B MacEachen, WestMARC, Southern General Hospital, Glasgow, UK

"Challenges of a Trans radial"
J Ronald, Nottingham, UK

"Analysing the relationship between socket design and electrode contact with myoelectric prostheses functionality: a prosthesis user questionnaire"
J Head, University of Salford, Salford, UK

"Changes in prehension over training with a myoelectric simulator"
R Bongers, Center for Human Movement Sciences, University of Groningen, The Netherlands

"Effect of a multifunctional prosthetic hand on hand functioning, activity, and psychosocial adjustment"
L Hermansson, Centre for Rehabilitation Research, Orebro, Sweden

1000 – 1030 hrs **Evidence Based Practice**
Guest Speaker: to be confirmed

1030 – 1100 hrs **Refreshments**

1100 – 1200 hrs **Free Paper Session** *Chair: Paul Steeper/ Stephen Laird*

"Upper Limb Prosthetic Outcome Measures (ULPOM) Group"
P Kyberd, Institute of Biomedical Engineering, University of New Brunswick, Canada

"A new active shoulder prosthesis: from the design to the first clinical application"
E Gruppioni, I.N.A.I.L., Prosthesis Centre, Vigorso di Budrio, Italy

"Feasibility of activity monitoring for upper limb prosthetic evaluation"
M Sobuh, University of Salford, Salford, UK

"Use of rapid prototyping technology in producing silicone partial hand prostheses"
T Maver, Institute for Rehabilitation, Ljubljana, Republic of Slovenia

"High definition silicone cosmesis and upper limb absence: a user's questionnaire"
R Beltran, Roehampton Rehabilitation Centre, London, UK

"Light-weight full arm cosmetic prostheses for high level amputees"
N Hillsdon, Roehampton Rehabilitation Centre, London, UK

1200 – 1300 hrs **Lunch**

1300 – 1400 hrs **Instructional Workshops**

(1) "Building blocks for a prosthetic training program" - Kristin Gulick, OTR/L, CHT, Org, USA

(2) "Harnessing and control techniques" - Michael Fillauer, The Fillauer Companies Inc., Tennessee, USA; Debra Latour, M.Ed., OTR/L, Shriners Hospitals for Children, MA, USA

(3) "The Evolution of Upper Limb Prosthetic Socket Design" and "Management of Bilateral Upper Limb Deficient Individual" John Miguelez, Advanced Arm Dynamics, Org, USA

(4) "Silicone – innovative solutions in upper extremity prosthetics" - Jiri Rosicky, Czech Republic; Bob Watts, Dorset Orthopaedic, UK; Michael Schaefer, Germany

1400 – 1415 hrs **Refreshments**

1415 – 1515 hrs **Instructional Workshops**

(5) "Building blocks for a prosthetic training program" - Kristin Gulick, OTR/L, CHT, Org, USA

(6) "Harnessing and control techniques"- Michael Fillauer, The Fillauer Companies Inc., Tennessee, USA; Debra Latour, M.Ed., OTR/L, Shriners Hospitals for Children, MA, USA

(7) "The Evolution of Upper Limb Prosthetic Socket Design" and "Management of Bilateral Upper Limb Deficient Individual" John Miguelez, Advanced Arm Dynamics, Org, USA

(8) "Silicone – innovative solutions in upper extremity prosthetics"- Jiri Rosicky, Czech Republic; Bob Watts, Dorset Orthopaedic, UK; Michael Schaefer, Germany

1515 – 1530 hrs **Prizegiving**
Wind up
Symposium Closes

MANUFACTURER'S WORKSHOPS

Tuesday 19 May 2009

Manufacturer's Workshop 1:
Advances in elbow, TD & wrists for upper extremity function – Motion Control Inc

This workshop will deal with specifics and hands-on experience with new features in the U3+ Arm, including Dual Locking System, silent low power freeswing and compatibility with new TDs, such as the i-LIMB hand. Hands-on instruction in the user interface software, used with the new U3+ Arm as well as ProControl 2, and now with Bluetooth wireless connection to all MC systems. Delegates will have the opportunity to install the new software. In addition the workshop will deal with specifics and hands-on experience of the highly functional Motion Control Hand and Electric Terminal Device (ETD) including: flexion wrist, multi-flex wrist, in-hand wrist rotation as well as new battery options. Finally specifics and hands-on experience with the new Hybrid Utah Arm will be presented – adjustable Flexion Assist eases elbow flexion in this body-powered elbow, with myoelectric hand and wrist control, electric lock control and a wide variety of input sensors, and control options.

Manufacturer's Workshop 2:
PAULA: Technology for evaluation, fitting and training for upper limb prosthetics - Otto Bock

Presented by Martin Werhle and Ken Hurst, three workstations will demonstrate differing aspects of the new PAULA software. Delegates will be able to view myo testing, assistive socket design, component selection and full myo simulation of dynamic arm. The sessions will be instructive as well as interactive.

1. PAULA Workstation **MyoTest** – MyoTest with MyoBoy to find good signals at different levels (eg. transradial and transhumeral) and classify the myo signals to aid prescription.
2. PAULA Workstation **Socket Design** – will show the data capture and processing of photographs to create an electronic transradial test socket.
3. PAULA Workstation **MyoSimulation** – will simulate different component configurations on screen with the PAULA Software including children hand system, adult system and dynamic arm.

The sessions will include working with real prosthetic examples, with an overall goal of helping delegates to understand the ability of PAULA to progress through the assessment process without the need for actual components in their workshop or the need to take a conventional plastercast.

Manufacturer's Workshop 3:
Achieving goals and satisfying ADL requirements – RSL Steeper

Presented by John Ronald and Bruce Rattray. Allowing the user to achieve their goals and satisfy all their ADL requirements often warrants novel approaches and a variety of terminal devices. This workshop will focus on prescription choices that are available and a particular partial hand case study will be discussed giving an insight into the components chosen to satisfy the user's needs. Proceedings will be informal to encourage feedback and discussion and there will be the opportunity to discuss other challenging cases. In addition, new technology advancements will be discussed with a presentation focussing on how myo electric signals may be captured in patients utilising suction style liners.

Manufacturer's Workshop 4:
i-LIMB Hand – Touch Bionics

Since the release of the i-LIMB Hand in July 2007, more than 500 patients worldwide have been fitted with this most advanced prosthetic hand which has multiple advanced grip patterns similar to that of a human hand. The i-LIMB is the world's first microprocessor controlled, myo-electric hand with proportional control, five articulating digits and a user adjustable thumb which rotates 110 degrees. This gives the user a "palmar grip" which enables the user to have grasp and control which heretofore was not available. The i-LIMB Hand can lift 45 pounds and yet the articulating fingers produce a realistic movement naturally conforming to the shape of the objects. The workshop, geared towards prosthetists, OTs and hand therapists, will cover basic grip patterns, new updates on the i-LIMB Hand (eg. small female hand), cosmesis, clinical background, patient training (OT protocol), patient study, service and support.

Manufacturer's Workshop 5:
Silicone Processing Techniques – Polymer Systems Technology Ltd.

Incorporating the use of a powerpoint presentation, this workshop intends to cover

- The choice of an HCR before proceeding to the actual silicone processing technique (ie what factors need to be considered such as the Shore hardness and durometer of the silicone
- Preparation of the materials and the equipment
- How to adjust the work time and cure schedule as required
- Avoiding inhibition during the process
- Removing air and how to avoid bubbles during the silicone processing technique

INSTRUCTIONAL WORKSHOPS

Wednesday 20 May 2009

Instructional Workshop 1:
Building blocks for a prosthetic training programme – Kristin Gulick, OTR/L, CHT

While every rehabilitation program needs to be client centered, it is helpful to have a basic treatment approach that can be modified to fit the individual client. Education about prosthetic training that most US occupational therapists receive in school is very limited and thus a therapist who prepares to provide treatment for a client with upper limb loss can feel less than prepared. This workshop will describe an approach to prosthetic training based on rehabilitation stages beginning with acute injury management progressing through pre-prosthetic>basic prosthetic>advanced prosthetic>community reintegration. Basic anatomy will be reviewed and terminology will be defined. Examples of patient cases using a variety of current technology will be shared. The information offered in this workshop will provide an example of an approach to the rehabilitation of a client with upper limb loss while also demonstrating how to tailor a program to address individual client needs and desires. Resources will be shared for future reference.

Instructional Workshop 2:
Silicone – innovative solutions in upper extremity prosthetics

Custom made silicone prostheses under the use of CAD systems – **Jiri Rosicky, ING Corporation, Czech Republic**

New possibilities in the treatment of children with myoelectric below-elbow prostheses - **Bob Watts, Dorset Orthopaedic, UK**

Silicone socket design in upper extremity prosthetics (finger to shoulder) - **Michael Schaefer, Pohlig GmbH, Germany**

Instructional Workshop 3:
Alternative Harnessing Techniques – Michael Fillauer, CPO, USA, The Fillauer Companies Inc.

This workshop will first review the biomechanical work sources for body power control with respect to power and excursion. Current harnessing techniques will be illustrated and evaluated based on patient acceptance, suspension and functionality. Alternative harnesses will also be discussed to address individual patient requirements and functional goals. Unique characteristics will be shared with the intent of increasing harnessing options.

The Anchor for UE Use – Debra Latour, M.Ed OTR/L, Shriners Hospitals for Children, USA

Traditionally, a body-powered prosthesis is activated by a figure-of-eight or nine harness system using the contralateral shoulder as the power source. Many users of this system complain of discomfort from the harness rubbing on the skin, especially in the axilla region. The “Anchor” system eliminates the need for a harness and the benefits of the system include increased comfort, improved cosmesis and decreased impingement at the axilla.

Instructional Workshop 4:
John Miguelez, CP, FAAOP, Advanced Arm Dynamics, USA

The Evolution of Upper Limb Prosthetic Design Socket

Well thought out interface designs and careful consideration of residual limb presentation set the stage for patient success –maximizing range of motion, providing stability throughout daily activities and comfortably distributing the forces exerted on the residual limb during movement as well as suspension. In contrast, poor interface design will often drive people to abandon the prosthesis since many patients have an intact arm or hand. The foundation for all prosthetic procedures is a well designed and considerate prosthetic interface. This workshop will shed light on the many variables behind the evolution of upper limb interface design. Review of historical literature reveals two distinct and major influences – material science and the emerging upper limb prosthetic specialist.

Management of the Bilateral Upper Limb Deficient Individual

The patient population that requires bilateral upper extremity electrically-powered prosthetic intervention is limited, as are the practitioners who have sufficient experience to meet the patients' myriad of goals. Maximizing a patient's rehabilitation potential involves several critical success factors. Formation of a rehabilitation plan via a team approach ensures that all aspects of care are addressed simultaneously and is essential to a positive result which includes significant improvement in function and long-term prosthetic use. Essential in the formation and execution of successful prosthetic rehabilitation is the knowledge of design theory. Design theory takes into consideration volume containment, suspension, comfort, range of motion, component considerations, stabilization, anatomical contouring, and cosmesis. This knowledge allows the team to select the appropriate interface design, componentry, and control schemes that best suit the patient's level of amputation, skin, tissue, musculature condition, range of motion, learning ability and desire, and vocational and avocational goals. While knowledge of design theory in itself does not guarantee successful prosthetic rehabilitation, a lack of knowledge can often overshadow the contributions of the rehabilitation team. This workshop will detail a protocol to address the critical factors that should be considered when bilateral upper extremity electrically-powered prostheses are prescribed.

GUEST SPEAKER BIOGRAPHIES

Kristin Gulick

Occupational Therapist and Certified Hand Therapist, Kristin Gulick, has over twenty years' specialist experience and is renowned for her unique and intense approach which has benefitted patients across the USA. Kristin is committed to sharing her knowledge and wealth of experience through training programmes for community therapists involved in local care of patients with upper limb amputation. Together with Katie Yancosek, MS, OTR, CHT, she has recently published a handwriting manual for adults who are changing hand dominance.

Stephanie Lacour

Stéphanie Lacour received her M.S. degree in 1998 and Ph.D. in 2001 in Integrated Electronic Devices from the Institut National des Sciences Appliquées (INSA) in Lyon, France. From 2001 to 2005 she was on the research staff of the Department of Electrical Engineering at Princeton University, NJ working on thin film electronics on polymeric substrates and stretchable electronics. She joined the University of Cambridge in January 2006 to co-ordinate a multidisciplinary team that develops compliant regenerative electrodes for nerve repair. In October 2007 she was appointed a University Research Fellow of the Royal Society leading interdisciplinary research on integrating electronic, transducing, and biologic functions on soft and compliant substrates. In September 2006, she received the Young Innovator award, TR35, from MIT Technology Review. She is also a research fellow of King's College in Cambridge.

Frank Letch

Frank Letch was born with major upper limb deficiencies. A retired teacher, he is married with a family of five. He is a stalwart and enthusiastic supporter of REACH and a member of its board of trustees having previously served as Chairman two years. During this period Frank oversaw some exciting developments within the organisation and was a major force behind initiatives to cater for teenagers and older children. Frank introduced the Calvert Trust Outward Bound Camp as the REACH Millennium project and worked tirelessly at fundraising to ensure its success. He contributes regularly to the REACH magazine (Within Reach) giving advice on various topics as 'Agony Uncle' and writing articles. Frank is also an accomplished public speaker. He travels far and wide spreading the word about REACH and doing his now famous 'Feet First' talk describing his day-to-day life, and demonstrating (among other things) how he chops an onion with his feet!

John Miguelez

Founder of Advanced Arm Dynamics in 1998, John Miguelez has specialized in upper-extremity prosthetics for 18 years. John is the former Founder, Vice President and Senior Clinical Director for the National Upper Extremity Prosthetic Program at NovaCare, Inc., now Hanger Prosthetics & Orthotics. After launching NovaCare's Program in 1991, he successfully led 28 regional upper-extremity prosthetic specialists, the Upper Extremity Research and Fabrication Center and a national team responsible for patient coordination and insurance justification serving 3,000 patients a year.

John has published several articles in the *Journal of Prosthetics and Orthotics* and the *Atlas of Amputations and Limb Deficiencies* and conducts lectures nationally and internationally. He manages clinics throughout the United States for patients with challenging upper-extremity prosthetic requirements and is also involved in several research and development initiatives, working closely with upper-extremity component manufacturers on education, component refinement and design.

Since 2003, John has led a team of senior clinicians at Walter Reed Army Medical Center in Washington, D.C., providing care at the request of the Department of Defense to injured U.S. soldiers from Iraq and Afghanistan. Here he and his team offer prosthetic services to patients with amputations of all levels and in all areas of the rehabilitation process.

John attended the University of Southern California and received his Prosthetics Certificate from Northwestern University. He is an American Board for Certification (ABC) certified prosthetist and is certified by all leading component manufacturers for upper-extremity prosthetics, including Otto Bock, Motion Control, Liberating Technologies and Hosmer. He has served as a clinical instructor for Motion Control and Liberating Technologies for several years; is a Fellow of the American Academy of Orthotists and Prosthetists and the former Chair of the Academy's Upper-Limb Prosthetics Society. He is also a member of the board of directors for the International Society of Prosthetists and Orthotics (ISPO).

ABSTRACTS
(in order of presentation)

Monday 18 May 2009

Title: **Upper Extremity Prosthetics: State of the Science**

Presenter: John M Miguelez, CP, FAAOP

Contact: Advanced Arm Dynamics Inc
123 West Torrance Boulevard, Suite 203
Redondo Beach, CA 90277
USA

Tel: 001-301-372-3050
Fax: 001-301-372-3057
E-mail: jmiguelez@armdynamics.com

The State of the Science in the field of upper extremity prosthetics is strong. New developments in component design, fitting techniques, and material science are allowing prosthetists to fit upper extremity prostheses with increased function, reliability, and cosmesis. The misconception that upper extremity prostheses ultimately fail is now beginning to change because of the diligent work of so many contributors in the medical, research, and engineering arenas. Although we can now see into the horizon of what is to come and are excited about the potential for improved function for these individuals, we must not forget about our history and how far this field has already come. Current technology allows for serious return to function for our patients and provides the opportunity for individuals to live in a bimanual world. Even those levels of amputation that were previously difficult or impossible to fit such as the partial hand or the shoulder disarticulation level are now being fit with highly functional prostheses because of improved technologies and fitting techniques. This is truly a time of revolution in the field of upper extremity prosthetics and both the future and the present are exceptionally bright.

Reflective Notes

Title: **Towards multi-movement hand prostheses: combining adaptive classification with high precision socket**

Author: Michael Winkler

Presenter: Alexander Boschmann, University of Paderborn, Germany

Contact: Michael Winkler
O.T.W. Orthopädietechnik Winkler
Minden, Germany

E-mail: Info@winkler-ot.com

Other Authors: Alexander Boschmann, Paul Kaufmann, Marco Platzner
University of Paderborn, Germany

The acceptance of hand prostheses strongly depends on their user-friendliness and functionality.

Current prostheses are limited to a few movements and the operation is all but intuitive.
The development of practical applicable multi-movement prostheses requires the combination of modern signal classification methods with novel techniques for manufacturing high precision sockets.

In this paper we introduce an approach for classifying EMG signals taken from forearm muscles using Support Vector Machines. This classifying technique is used in an adaptive operation mode and customised to the amputee allowing us to recognize eleven different hand movements with high accuracy.

We will present a novel manufacturing technique for prosthesis sockets enabling precise amputee-specific fitting and EMG sensor placement.

Reflective Notes

Title: **A Voice-Controlled Prosthesis: Test of a Vocabulary and Development of the Prototype**

Presenter: Gruppioni E.[1], Saldutto B.G.[1], Mainardi E.[2], Davalli A.[1], Cutti A.G.[1]

Contact: [1] I.N.A.I.L. Prosthesis Centre, Vigorso di Budrio, Italy
[2] Dept. of Engineering, University of Ferrara, Italy

E-mail: ag.cutti@inail.it

Current solutions for the control of active upper-limb prostheses are mostly based on EMG signals acquisition and processing and on electronic switches. Even though efficient for most clinical cases, these solutions can be unsatisfactory for the control of prostheses with multiple joints, e.g. comprising an active shoulder, elbow, wrist and hand. Voice-control can be a possible solution for these clinical cases. The aims of this work were therefore 1) to identify a non-redundant vocabulary for the voice-control of an active upper-limb prosthesis, by maximising the recognition performances of the voice controller VR-STAMP (Sensory Inc., Sunnyvale California), and 2) to integrate the VR-STAMP with a prosthesis controller.

For the definition of the vocabulary, 16 subjects were involved in the experiments. A vocabulary of 36 words was initially identified, comparing alternative words to trigger the same action of the prosthesis. To choose the best word between alternatives we checked the number of false-positive recognized by VR-STAMP. After completing the selection, a non-redundant vocabulary of 26 words was obtained. Subsequently, we checked for statistically significant differences between the number of true-positive recognitions of the words of the non non-redundant vocabulary. No statistically significant differences were found. The median number of recognitions per word per subject was 10/10 with an interquartile distance of 1.

For the development of the voice-controlled prosthesis, a firmware for the VR-STAMP was firstly developed; then, the VR-STAMP was interfaced via serial-port with the prosthesis controller CLC2000 developed and commonly used by the INAIL Prostheses Centre.

A video of the prototype is available at www.inail-starter.org/Downloads.html

Reflective Notes

Title:	**A use of Rapid Prototyping in prosthetics: Wrist Powered Partial hand with Multi-articulate Jointed fingers**

Presenter: Adam MP Clawson, MEng, PhD Candidate, Design Engineer, Mr

Contact: Institute of Biomedical Engineering
University of New Brunswick
25 Dineen Drive
Fredericton, NB, E3B 5A3
CANADA

Tel: +1 506 453 4966
Fax: +1 506 453 4827
E-mail: adam.clawson@unb.ca

Other Authors: G.Bush, BA, CP(C), Institute of Biomedical Engineering, UNB, Canada
W.Hill, BSc, OT(C), Institute of Biomedical Engineering, UNB, Canada
P.J.Kyberd, President's Chair in Rehabilitation Cybernetics, UNB, Canada

The nature of prosthetics is to create a device that matches the loss of the person. Attempts to customise the appearance of the prosthesis have been generally limited to the appearance of the devices, through customisation of the glove. The image of the intact contralateral limb is reflected on to the surface of the glove[1], or more usually, it is used in the the production of the socket. With the rise of compact rapid prototyping systems, it is becoming feasible to make other prosthetic parts that match the dimensions of the user's absence more precisely. In this study the rapid prototyping manufacturing technique of SLA (***S***tereo***L***ithography ***A***pparatus) is used on the design of a partial hand mechanism.

There have been a number of body powered fingers to replace individual digits suggested in the literature, [2] is one example. But if the loss of a finger leaves part of the metacarpophalangeal joint intact it is difficult to create effective active fingers within the space allowed. If the finger has a single point for the pivot to form axis of rotation of the digit, it requires a space greater than the distal end of the MCP to be missing. To overcome this a design for a modular finger replacement system has been created that conforms *around* residual MCP joints. While the centre of rotation is within the distal head of the MCP the prosthesis runs around a track that is part of a circle on the outside of the residual MCP.

Digit flexion is driven using the wrist flexion and elastic elements return the digit to extension. The individual joints on the phalanges of the digits are retained within tracks but are not pinned which allows some compliance and resistance to damage. The fingers use rapid prototyping for construction of the phalanxes so that the length can be made to match the bones of the individual. The specific construction method used creates parts from a nickel plated acrylic, giving a tough covering while maintaining low overall weight. This process is comparatively low in price, and has a turnaround of less than two weeks making is a practical alternative to traditional tooling methods.

The first of these have been fitted to an individual with the loss of third, fourth and fifth fingers due to a blast injury. The fingers are mounted on a rigid socket over a silicone pad on the distal aspect of the residuum. Wrist flexion is used to activate the fingers in a similar manner to a tenodesis orthosis.

[1] T. Maver, H. Burger et al. *The Use of High Resolution CAD-CAM Systems in the Manufacturing of Finger and Hand Prostheses.* Proceedings of 12th World Congress of ISPO, Vancouver, 2007. pp. 556.

[2] MJ Piley, DN Quinton *Digital prostheses for single finger amputations.* J Hand Surgery (Br)

Reflective Notes

Title: **Early Partial Hand Patient Outcomes Utilising ProDigits (Myoelectric Controlled Prosthetic Digits)**

Presenter: Karl Lindborg, Head of Clinical Advocacy, Touch Bionics, Certified Prosthetist & Orthotist

Contact: Unit 3, Ashwood Court
Oakbank Park Way
Livingston
EH53 OTH

Tel: 01506 438556
Fax: 01506 439698
Email: karl.lindborg@touchbionics.com

Other Authors: Tom Passero, Clinical Services Director, Touch Bionics
Wayne Fichtel, UK Clinic Manager, Touch Bionics

The treatment of amputees with through hand amputation as a result of either congential absence, or more commonly as a result of a traumatic event, has been mainly limited to either passive or body powered options.

Touch Bionics' objective has been to adapt its ProDigits technology (already successfully deployed as a main component of the i-LIMB Hand) to support patients who desire a powered digit option to increase dexterity and function. So far some 30+ early stage patients have been fitted with ProDigits technology – varying between 3 and 5 replacement fingers, both unilateral and bilateral.

The purpose of this presentation/paper will be to compare the varying techniques employed by both Touch Bionics and 3rd party prosthetists in developing patient solutions. Key points that will be addressed in detail; suspension, socket design, myoelectric signal input options (FSR or electrodes), thumb mounting, thumb rotation options, battery location, control strategies and cosmesis covering.

This review will share with other O&P professionals the knowledge that has been garnered over recent fittings and will address how these learnings is being applied to standardized techniques – which will include the adoption of 3D scanning for socket design, myoelectric site location and cosmesis development.

2 patient cases (from Spain and China) will be addressed and the results will include step-by-step details on patient evaluation, test socket development, signal sites, dynamic testing, second fit, final fit, familiarisation, covering development and occupational therapy.

Patient and professional testimonials will be supported by clinical narrative and step-by-step photos and video.

Reflective Notes

Title: **Natural grasping: On the design of voluntary closing hand prostheses**

Presenter: Dick H. Plettenburg, Ph.D.; Gerwin Smit, MSc.

Contact: Delft Institute of Prosthetics and Orthotics
Delft University of Technology
Mekelweg 2, 2628 CD Delft
The Netherlands

Tel: +31 15 278 5615
Fax: +31 15 278 4717
E-mail: d.h.plettenburg@tudelft.nl

The Delft Institute of Prosthetics and Orthotics has started a project to develop body-powered, voluntary closing mechanical hand prostheses with adaptive fingers in an attempt to meet the three basic requirements for a prosthesis: cosmetics, comfort, and control[1].

To apprehend the main problems in controlling a prosthesis, it is informative to consider such an assistive device as a mechanical extension to the natural system of the human body. Examples thereof are the stick of a blind person, a pair of tweezers, or a hammer. The way we use these devices shows that we feel them as part of our own body. In other words, the point at which we make contact with things that we consider as other than ourselves shifts outwards. Simpson[2] made this point very clear: "We pour ourselves out into them and assimilate them as parts of our own existence". Simpson also argued that the level of assimilation depends on feedback. To perceive bodily movements the body is equipped with several sensory systems. In this respect, the most important are the visual system and the proprioceptive system, of which the proprioceptive system is most suited to pick up information about a prosthesis because it feeds back both motion and forces to the control system, whereas the visual system can only detect motion. Furthermore, the feedback received from vision takes much more processing time than proprioceptive feedback. Would the system rely purely on vision to control limb movements then a close, continuous, and most importantly, conscious monitoring of the limb is needed in order to prevent difficulties. Providing proprioception relieves the user of this mental load. In sum, there are strong arguments that feedback about the movements and forces in a prosthesis should be provided through proprioceptive signals. Simpson introduced the term extended physiological proprioception in this respect.

The requirement that for optimal control of an assistive device feedback must be provided through proprioception implies the harnessing of body movements as control method. Using a body harness results in a direct relation between bodily produced movements and forces and the movements and forces in the prosthesis, and thus, provides accurate and fast proprioceptive feedback about the prosthesis. The movements of the prosthesis should be compatible to the bodily movements that produce these movements, i.e. extending a joint opens the prosthetic hand and flexing a joint closes it. Voluntary closing provides such a simple and direct relation. To achieve proper control and optimal feedback the interface design between the terminal device and the human operator should match the sensitivity requirements of the sensory system. Moreover, the mechanical efficiency should be as high as possible in order not to hamper the feedback. Therefore, disturbances in the transfer mechanism between the operator's body and the terminal device need to be avoided where possible and minimized where inevitable. This requires special attention to possible energy losses in the mechanisms. Overall, the new prosthesis concept and design is perceived as a breakthrough in prosthetics as it enhances the functional capacity of the user.

[1] Plettenburg DH, Upper extremity prosthetics. Current status and evaluation. VSSD, The Netherlands, ISBN-13: 978-90-71301-75-9, 2006
[2] Simpson D, The choice of control system for the multimovement prosthesis: extended physiological proprioception. In: Herberts P, Kadefors R, Magnusson R, Petersen I, editors. The control of upper-extremity prostheses and orthoses. Springfield: Charles C. Thomas, ISBN 0-398-02869-9, 1974, pp. 146 – 150

Reflective Notes

Title: **A Two Degree of Freedom Powered Prosthetic Wrist controlled using Pattern Recognition of forearm EMG**

Presenter: Peter Kyberd, PhD, President's Research Chair in Rehabilitation Cybernetics

Contact Address: Institute of Biomedical Engineering
University of New Brunswick
25 Dineen Drive
Fredericton, NB, E3B 5A3
CANADA

Tel: +1 506 453 4966
Fax: +1 506 453 4827
E-mail: pkyberd@unb.ca

Other Authors:
E. Scheme, Institute of Biomedical Engineering, UNB, Canada
E. Lemaire, The Ottawa Hospital Rehabilitation Centre, 505 Smyth Road, Ottawa, ON, Canada, K1H 8M2 Canada
L. Goudreau, The Ottawa Hospital Rehabilitation Centre, 505 Smyth Road, Ottawa, ON, Canada, K1H 8M2 Canada
M. Brookeshaw, Institute of Biomedical Engineering, UNB, Canada
C. MacPhail, Institute of Biomedical Engineering, UNB, Canada

Introduction

Current designs of prosthetic wrists are generally limited to a single degree of freedom. Due to physical constraints, this axis is usually pronation/supination. Increasingly, designs with extra passive motions are being introduced. Powered flexion is limited to the combined action in the Kesheng and Centri hands and it was only the Sven hand that powered both pronation/supination and flexion/extension with independent control.

Method

The ToMPAW arm was the first modular prosthetic arm with bus based communications [1]. The design included a powered two degree of freedom wrist. Two motors are placed across the line of the arm in the base of the hand with both motors driving both degrees of freedom through a differential mechanism. By using a differential as the joint axis both motions are created at the same point in the arm and, as a result, occupy less space.

An embedded controller communicates with the rest of the arm using the bus system. Recently, a more compact version of the wrist has been built and controlled using a pattern recognition system that allows both degrees of freedom to be controlled simultaneously and independently.

Pattern recognition

The wrist was controlled (via the bus connection) using a modified version of UNB's ACE control software [2]. Four adhesive electrodes were placed at equidistant locations around the forearm at one third of its length, proximal to the elbow. Myoelectric signals corresponding to seven motions were collected from healthy subjects. The controller was trained using myoelectric signals collected while prompting each subject to perform seven classes of contraction: wrist pro/supination, wrist flexion/extension, hand open/close and no movement. User intent was derived using a myoelectric control scheme previously reported. These outputs were then passed to the wrist mechanism in real-time to control its motions.

Results

Using two motors to drive both motions facilitates simultaneous control of both degrees of freedom (DOF), while allowing power to be drawn from both motors when only single DOF motions are needed. This provides speed and flexibility for complex pre-positioning motions, and power for single targeted movements.

The latest design is 60mm x 60mm x 30mm and occupies 40mm of length within the hand shell, but only 20mm on the proximal side of the joint axis, broadening the potential user population. The pattern recognition system had a recognition rate of greater than 98% for all commands.

Conclusion

This artificial wrist design provides a more compact and functional design without sacrificing weight or space.

[1] P.Kyberd, et al., *The ToMPAW modular prosthesis - A Platform for Research in Upper Limb Prosthetics.* JPO. 19(1), January 2007, pp. 15-21.

[2] E. Scheme et al., *A Flexible User Interface for Rapid Prototyping of Advanced Real-Time Myoelectric Control Schemes*, Proceedings of the MEC Symposium, Fredericton, NB, 2008, pp.150-155.

Reflective Notes

Title: **Prosthetic electronic skin: how to integrate sensory feedback on conformal artificial skin?**

Presenter: Dr Stephanie P Lacour

Contact: University of Cambridge
Nanoscience Centre
Cambridge, CB3 0FF

Tel: 00 44 1223 760 307

E-mail: spl37@cam.ac.uk

Over the last 5 years, considerable efforts have been spent in developing integrated prosthetic limbs that can restore significant motor functions of the natural limb. One of the remaining challenges to produce prosthetic limbs that would "feel" like the natural limb is to integrate in those mechanical prostheses the sensory feedback embedded in the skin.

Two challenges need to be tackled: (1) preparing an electronic sensory skin that looks and senses like human skin, and can wrap every contour and move in tandem with the prosthetic limb; (2) developing long-term neural interfaces for natural feedback.

Both tasks require finding materials, designs, and fabrication processes which will enable high level of computing and (bio)mechanical compliance. This is not obvious as current integrated circuits are rigid, stiff and flat.

We are developing the technology enabling the fabrication of artificial skins, i.e. human-sized integrated circuits that can conform to the human body and communicate directly with the nervous system. I will report on our latest findings on skin-like touch sensors and peripheral nerve interfaces.

Reflective Notes

Title: **A Cross Sectional Study of Amputees at a Syndey Amputee Clinic**

Presenter: J Davidson

Contact: Prince of Wales Hospital
Randwick
Sydney, NSW 2001
Australia

Tel: +61 2 9382 5078
Fax: + 61 2 9389 0632
Email: judyeastot@gmail.com

Other Author s: Dr K E Khor, Dr L Jones,

Background and Aim of Research
Long term studies of amputees indicate that phantom pain is a common occurrence but the reports of incidence various considerably. This study aimed to examine the pain characteristics and health related quality of life of a sample of amputees in an amputee clinic in a major Sydney Hospital.

Method
This study is of 39 lower limb amputees and 17 upper limb amputees who attended the Prince of Wales Amputee Clinic during 2006. Each amputee completed a survey of their pain experiences as well as the SF36 and SEQ.

Results
Upper Limb Amputees experienced pain with significantly greater frequency, greater severity and greater duration than lower limb amputees.

- The upper limb amputees are 2.3 times more likely to experience moderate and severe pain after amputation compared to lower limb amputees. ($\chi 2=6.61$ $p = 0.001$)
- The upper limb amputees are 2.8 times more likely to suffer daily pain compared to the lower limb amputees. ($\chi 2=17.5$; $p = 0.0001$)
- The upper limb amputee is significantly more likely to suffer from constant pain compared to the lower limb amputee who is more likely to suffer from intermittent pain ($\chi 2=9.59$; $p = 0.008$)

On the SF36, the lower limb amputees experienced a better health status than the upper limb amputees.

- The lower limb amputees had more impaired physical function than upper limb amputees,
- The upper limb amputees were more affected in terms of their physical role limitation than the lower limb amputees.
- The amputees experienced a better health status than patients attending the Prince of Wales Chronic Pain Clinic but a reduced health status compared to the Australian population.

In terms of their confidence in performance of daily task despite their pain as measured by the PSEQ, the upper limb amputees scored 36.7 while the lower limb amputees scored 45. This suggests that the lower limb amputee group has higher level of confidence although the results did not reach statistical significance. However, both amputee groups have higher confidence compared to the chronic pain group (PSEQ=23)

Conclusion
Upper limb amputees are significantly more likely to have pain of greater frequency and severity than lower limb amputees. The lower limb amputee has a 36% chance of becoming pain free but the upper limb amputee can expect that phantom pain will continue indefinitely. Constant pain is uncommon in lower limb amputees (18%) but present in 64% of upper limb amputees.

Reflective Notes

Title: **The Effect that a Congenital Upper Limb Deficiency has on a child and his/her parent(s). Does a Prosthesis help?**

Presenter: M Punchard, Lead Prosthetic Therapist, Mrs

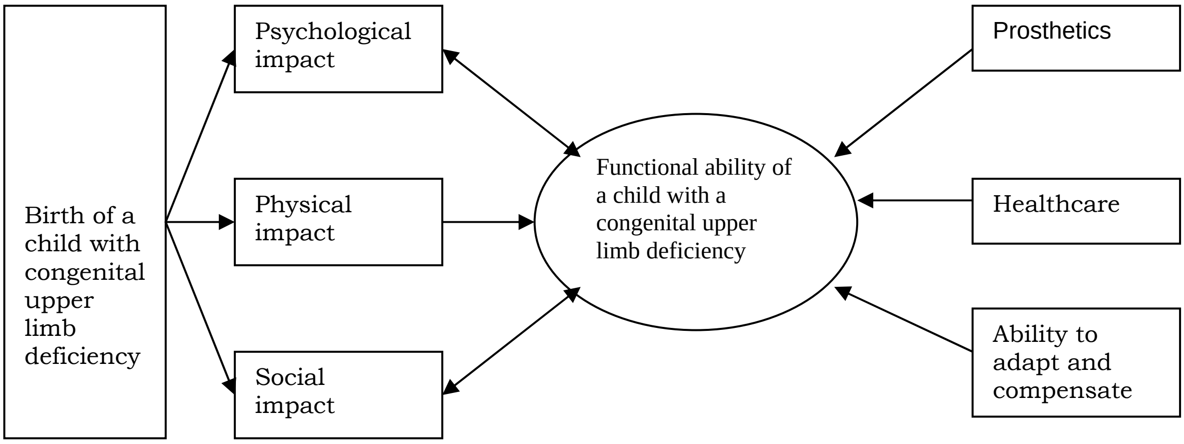
Contact: Exeter Mobility Centre
Off Lister Close
Wonford Road
Exeter
EX2 4DU

Tel: 01392 403649
Fax:01392 403667
e-mail: marnie.punchard@rdeft.nhs.uk

The aim of this research project is to explore the experiences that a congenital upper limb deficiency has on a child and his/ her parent(s), in relation to the use or non-use of a prosthesis. This research was part of a Masters degree in Occupational Therapy which was obtained in 2007, and received a favourable ethical opinion from the Regional Ethics Committee, taking into account the sensitive issue of involving children.

Research into this area is currently limited due to the small number of people born with congenital upper limb deficiencies. Although there are studies showing that large numbers of people with upper limb congenital limb deficiency do not wear a prosthesis (Postema et al,1999); there is little research looking at the experiences of children regarding the use or non-use of a prosthesis.

This research project has explored the impact a congenital upper limb deficiency has on a child and his/her parent(s). This was achieved using the qualitative approach of grounded theory. Nine children and their parent(s) participated in this study providing information in a semi-structured interview. The transcripts of the interviews were coded using open coding and 39 concepts were identified. These 39 concepts were explored and placed into nine categories during axial coding. The categories were named as: functional ability; physical impact; social impact; psychological impact; healthcare; prosthetics; ability to adapt and compensate and advice to others. The process of selective coding identified links between these categories and resulted in a visual model shown below that summarises the findings of this research.



The researcher believes that the research has expanded personal knowledge and understanding in this area. It is hoped that the visual model will enable professionals who can not fully answer the question "what is best for my child?" to be better informed regarding the experiences that a congenital upper limb deficiency has on a child and his/ her parent(s), and the options open to them. Healthcare professionals need to consider this group of children in a holistic way looking at their needs and not just concentrating on the prosthetic provision. The researcher believes that instead of assuming that a child should have a prosthesis further evidence is needed to assist in answering the question "why do they need one?" Recent evidence is pointing to the fact that prostheses may not enhance function (James et al 2006), and there is a lack of evidence as to whether a prosthesis does prevent overuse and postural problems.

References

Postema, K. Donk, F.v.d. Limbeek, J.v. Rijken, R. and Poelma,M. 1999. Prosthetic rejection in children with a unilateral congenital arm defect. Clinical Rehabilitation vol. 13 no.3 pp243-249(7).

James, M.A. Bagley, A.M. Brasington, K. Lutz, C. McConnell, S. and Molitor, F. 2006. Impact of Prostheses on Function and Quality of life for Children with Unilateral Congenital Below the Elbow Deficiency. *The Journal of Bone and Joint Surgery (American)* 88:2356-2365.

Reflective Notes

Title: **Management of musculo-skeletal symptoms of the contralateral limb in upper limb amputees**

Presenter: Dr S.Sooriakumaran, Consultant in Rehabilitation Medicine

Contact: Roehampton Rehabilitation Centre
Queen Mary's Hospital
Roehampton Lane
London, SW15 5PN

Tel: 0208 487 6800
Fax: 0208 487 6805
E-Mail: ssoori@wpct.nhs.uk

Aim:
A proactive approach to prevent musculo-skeletal problems in the intact upper limb.

Introduction:
Published articles on this subject remain limited. In the study quoted 50% of the 46 patients studied reported following problems of varying severity:

- Tenosynovitis
- Epicondylitis
- Carpal tunnel syndrome
- Shoulder impingement
- Diffuse overuse injuries

The problems were more prevalent in proximal amputations. Prosthetic use and lack of employment were not protective of remaining arm.

Management:
Following are key elements of prevention:

- Screening about the risk of overuse injuries
- Adjustment of pre-amputation sports
- Proactive approach with functional prosthesis
- Occupational & physiotherapy advice regarding employment
- Vocational training to change occupation

Treatment:
- Physiotherapy techniques
- Rheumatological interventions - oral or injection treatment
- Avoidance of precipitating activities

Case study:
Summary of 2 cases will be presented to illustrate the above-mentioned aspects.

Reference:
Save that arm: a study of problems in the remaining arm of unilateral upper limb amputees. L E Jones and J H Davidson; *Prosthetics and Orthotics International, 1999, 23, 55-58*

Reflective Notes

Title: **Does silicone partial hand prosthesis improve ability to work?**

Presenter: Helena Burger, MD, PhD

Contact: Institute for Rehabilitation
Linartova 51
1000 Ljubljana, Slovenia

Tel: + 386 (0)1 4758 100
E-mail: helena.burger@ir-rs.si

Other Author: Tomaž Maver, CPO

Aims and objectives: Amputation, even only of a very small part of one finger, results in both psychological and functional loss, as well as in a decrease in life satisfaction. A finger prosthesis does not have psychological but also functional benefits, such as increased pinch and grip strength and improved performance of ADL (Lifchez 2005, Hopper 2000). About one quarter of patients after partial hand amputation have to change their jobs. The use of prosthesis at work depends on several factors, such as work type (manual or non-manual), gender, stump problems and amputation level (Hopper 2000).

The aim of the study was to find whether silicone finger prosthesis could improve return to work, specially to the same job.

Methods: A questionnaire was sent to all the patients (112 subjects) visiting the upper limb prosthetic clinic at the Institute for Rehabilitation in Ljubljana. The data were statistically analyzed.

Results: Answers were obtained from 26 (54.2%) men and 22 (48.8%) women. They were 44 years old on average (SD 16 years) at the time of the study. Twenty (41.7%) had a single finger amputation. The most frequent amputation was that of index finger through the PIP joint or through the middle phalange. On average, they finished 11 years of schooling (SD 2.5 years). After the amputation, 41.2 percent kept the same job as before, 35.3 percent had to change their job and 23.5 percent had to retired due to the injury.

More heavy manual workers than non-manual workers had to change their job or retire after the amputation ($p < .05$). None of the subjects with an amputation of three or more fingers was able to keep the same job after the amputation. Twelve out of 26 working subjects (46.2%) did not wear their silicone finger prostheses at work, six (23.1%) sometimes and eight (30.8%) wore it regularly at work. Prosthesis was more often used by the women and the subjects with non-manual work. The majority of the subjects in this study found their prosthesis not useful for work, and only one subject said that she could not type without it.

Conclusions: An esthetic silicone prosthesis is helpful particularly for subjects with higher education whose work involves personal contacts and for whom esthetics is important. They use the prosthesis for certain activities, such as typing. Further studies on a larger number of subjects would demonstrate additional benefits.

References:

Hopper RA, Griffths S, Murray J, Manktelow RT. Factors influencing use of digital prostheses in workers' compensation recipients. Journal of Hand Surgery – American Volume 2000; 25A: 80 – 85.
Lifchez SD, Marchant-Hanson J, Matloub HS, Sanger JR, Dzwierzynski WW, Nguyen HH. Functional improvement with digital prosthesis use after multiple digit amputations. Journal of Hand Surgery – American Volume 2005; 30A: 790 – 794.

Reflective Notes

Title: **A Service evaluation of currently prescribed cosmetic gloves and consequent implementation of Regal gloves for upper limb prostheses**

Presenters: Morven Hewitson, Snr Prosthetist, Mrs
Anne Silitoe, Snr Prosthetist, Mrs

Contact : Prosthetic Dept
SMART Centre
Astley Ainslie Hospital
133 Grange Loan
Edinburgh, EH8 9JW

Tel: 0131 537 4937
E-mail: morven.stanners@nhslothian.scot.nhs.uk

- A number of cosmetic upper limb patients raised concerns with their current cosmetic glove prescription due to factors such as colour, detail and durability. As clinicians, we require cosmetic gloves to be cost effective yet acceptable to the patient. A service evaluation was carried out in order to attempt to satisfy all parameters and consequently led to the trial of Regal gloves in June 08 to a small group of patients. This paper will discuss our findings.

- 20, established, upper limb patients (17 trans-radial, 2 trans-humeral and 1 partial hand) were involved in this evaluation. Records were kept of when new gloves were

- required and supplied and costs of gloves noted. Patient comments regarding satisfaction of Regal gloves was also noted.

- Results indicate that this evaluation requires to continue for a longer period of time for cost effectiveness to be properly evaluated, however, initial indications suggest that Regal gloves may be more durable and result in higher patient satisfaction than currently prescribed cosmetic gloves, and are a valid prescription option.

Reflective Notes

Title: **From activity to participation – a case presentation**

Presenter: Zdenka Pihlar, OT

Contac: Institute for Rehabilitation
Linartova 51
1000 Ljubljana, Slovenia

Tel: +386 (0)1 4758 100
E-mail: zdenka.pihlar@ir-rs.si

Other Author: Agata Križnar, OT, Julija Ocepek, OT

Aims and objectives

The aim of the present study is to present different methods and approaches an occupational therapist may use when working with a person after bilateral trans-radial amputation. The methods and approaches aim at achieving that person's maximal independence in self-care and maximal reintegration and participation in all fields of human functioning.

Subject and Methods
A thirty-nine-year-old music teacher felt under a train 14 years ago and suffered bilateral trans-tibial and bilateral trans-radial amputations. Left trans-radial stump is very short, which greatly influences the flexion. In another institution he had been fitted with lower limb prostheses and cosmetic upper limb prostheses. He was completely dependent in all ADL, except walking and had retired because of amputations.

The patient was admitted to the Institute to improve his functioning. At admission and at discharge his functioning was assessed by COPM (Canadian Occupational Performance Measure) (McColl 2006, law 2005).

Results
At the Institute, the patient was fitted with body-powered trans-radial prostheses and provided with assistive devices for eating and playing on the keyboard. He also got a toilet wheelchair.

His main points of interest were eating, shaving and playing musical instruments. At admission, his performance was assessed at 1.3 and satisfaction at 1.6. At discharge performance increased to 9.3 and satisfaction to 10.

The patient preferred to eat with eating devices which he was able to fit independently. With them he was quicker and more skilled than with the prostheses. He still needed help in cutting the food. With an assistive device for playing keyboards he was able to play music again.

Conclusions
The case presents the importance of evidence-based occupational therapy which has to focus on individuals and their needs. The patient needs be included into goal setting and therapy planning. The presented subject had been completely dependent in all ADL and socially isolated for many years. At discharge, his independence, self-confidence, self-esteem and also the quality of life greatly increased. An occupational therapist with good knowledge of prosthetic possibilities and of problems that persons after upper limb amputation may face has to be a member of each rehabilitation team treating persons after upper limb amputation.

References:

1. McColl MA, Carswell A, Law M, Baptiste S, Pollock N, Polatajko H. Research on the Canadian Occupational Performance Measure (4th ed.). Ottawa: Canadian Association of Occupational Therapists, 2006.
2. Law M, Baptiste S, Carswell A, McColl MA, Polatajko H, Pollock N. The Canadian Occupational Performance Measure (4th ed.). Ottawa: Canadian Association of Occupational Therapists, 2005.

Reflective Notes

Title: **Audit of the outcome of hypnosis as a treatment of Phantom Limb Pain**

Presenter: Michelle Wong Li Tyng, 5th Year Medical Student, Miss

Contact: Specialist Mobility Rehabilitation Centre,
Preston Business Centre
Watling Street Road
Fulwood
Preston, PR2 8DY

Tel: 01772 523853
E-mail: Fergus.Jepson@lthtr.nhs.uk

Other Authors: Dr F.K.Jepson, Consultant in Rehabilitation Medicine, Dr
Miss C.Bamford, Counselling Psychologist,
Lancashire Teaching Hospitals NHS Foundation Trust

Aims: to evaluate the effectiveness of hypnosis[1] in the management of phantom limb pain. This was carried out using by a qualitative telephone questionnaire survey and a single auditor.

Method: The inclusion criteria included consenting patients, completion of a course of hypnosis in the previous 12 months for the management of phantom limb pain.

The exclusion criteria included concurrent Eye Movement Desensitisation and Reprogramming treatment, counselling, serious ill health or declining to participate.

The questionnaire assessed the levels of pain (using the verbal rating scale[2]) before and after the course of hypnosis, the current level of pain, level of amputation, reason for amputation, alterations in medications, pre-treatment views on hypnosis, reason for hypnosis, number of hypnosis sessions, use of the personalised self-hypnosis CD, alternative therapies, level of activity before and after course, other benefits perceived and if the patient would recommend hypnosis.

Results: 33 subjects were identified of which 5 were unavailable during the audit period, 2 were un-contactable and 3 declined to be part of the audit. Consent was gained prior to the questionnaire. 23 amputees were included in the audit. There were 22 lower limb amputees (12 transfemoral and 10 transtibial) and 1 upper limb amputee

The results demonstrated a reported 44% overall drop in level of pain from pre-course to immediately post-course (37% - transfemoral and 48% transtibial amputees). This increased to a 54% reduction in pain (50% - transfemoral and 56% - transtibial amputees) from pre-course to time of questionnaire. There was a decrease in analgesia usage in 40% of patients (60% reported no change). A small number of patients had the maximum pain score pre and post course and at the time of the questionnaire.

The activity levels were assessed using the SIGAM grading and K-level scale. In both assessments there was no change in activity levels pre and post hypnosis.

The average number of sessions of hypnosis was 3.1 for transfemoral and 2.2 for transtibial amputees.

83% of the patients stated they would recommend hypnosis.

Other therapies that were tried included acupuncture, pain clinic, injections and Reiki.

Other reported benefits of hypnosis included relaxation, improved sleep, calming and an associated improved coping with pain from arthritis and Systemic Lupus Erythematosus.

The limitations of this audit include the small sample size, reliance on the patients' answers and possible Halo and Hawthorne effect.

Conclusion: this audit suggests hypnosis is an effective therapy in management of phantom limb pain in amputees with an overall reduction in long-term pain of 54%. There are other benefits such as a reduction in medication (40% of patients), relaxation and improved sleep. The audit supports the use of hypnosis and further investigation.

References:

[1] Bamford C. A Multifaceted Approach to the Treatment of Phantom Limb Pain Using Hypnosis. Contemporary Hypnosis, 2006; 23: 115 – 126.

[2] Randall C et al. A comparison of the verbal rating scale and the visual analog scale for pain assessment. The Internet Journal of Anesthesiology

http://www.ispub.com/ostia/index.php?xmlFilePath=journals/ija/vol8n1/vrs.xml

Reflective Notes

Title: **Use of an ITAP implant for prosthetic reconstruction of a transhumeral amputee**

Presenter: Norbert Kang FRCS (Plast), Consultant Plastic Surgeon, Mr

Contact: Department of Plastic Surgery
Royal Free Hospital NHS Trust
Pond Street
Hampstead
London NW3 2QG

Tel: 0208 794 0500 Ext 31459
E-mail: norbertkang@btinternet.com

Other Authors:
Dr Catherine Pendegrass PhD [a] – Biomedical Engineer
Dr Jay Meswania PhD[a] – Biomedical Engineer
Mr Stephen Cannon FRCS [b] – Consultant Orthopaedic Surgeon
Dr Linda Marks [b] – Consultant Rehabilitation Physician
Dr Paul Unwin PhD [a] – Biomedical Engineer
Professor Gordon Blunn PhD [a] – Biomedical Engineer

a) Centre for Biomedical Engineering, Royal National Orthopaedic Hospital, Brockley Hill, Stanmore HA7 4LP
b) Royal National Orthopaedic Hospital, Brockley Hill Stanmore HA7 4LP

Bone-anchored implants can be used to secure a prosthesis to the stump of a transhumeral amputee. Current evidence supports the view that such implants can increase the function and ease of use of a prosthetic limb. However, existing designs of implant focus solely on achieving osseointegration of the implant with the humerus. The long-term effects of having a metallic implant coming through the skin of the humeral stump have largely been ignored or have been dismissed as being a minor concern.

In reality, patients using a conventional implant often experience multiple problems with the soft-tissue/implant interface including; repeated episodes of infection and/or troublesome discharge from the interface. Exceptionally, the infection may be sufficiently severe to necessitate total removal of the implant. We have had a similar experience with the use of conventional implants used to secure an external prosthesis at other sites (e.g. to secure a prosthetic ear or eye).

We now report the use of a new type of bone-anchored implant which may represent a paradigm shift in our approach to prosthetic reconstruction of amputees. The intraosseous transcutaneous amputation prosthesis (ITAP) implant is the first implant specifically designed to achieve cutaneous integration. Cutaneous integration creates a stable interface between the implant and the soft-tissues reducing the risk of infection and troublesome discharge from this site.

We describe our early clinical experience with the use of an ITAP implant in a single transhumeral amputee. We discuss the general implications of such technology for prosthetic reconstruction using bone-anchored implants.

Reflective Notes

Title: **Clinical experience with the first upper limb ITAP recipient**

Presenters: Linda Marks, Consultant in Rehabilitation Medicine
Joy Rendell, Clinical Specialist Occupational Therapist

Contact: Stanmore Disablement Services Centre
Royal National Orthopaedic Centre
Brockley Hill
Stanmore
Middlesex
HA7 4LP

Tel: 0208 954 0020
Fax: 0208 420 7439
E-mail: linda.marks@rnoh.nhs.uk

Other Authors: Jennifer Fulton, Clinical Specialist physiotherapist, Stanmore DSC
Morven McAlinden, Senior prosthetist, CA Blatchford, Stanmore
Nancy Pretty, Senior prosthetist, CA Blatchford, Stanmore
Katrina Orme, Clinical Engineer, Stanmore Implants Worldwide
Norbert Kang, Consultant Plastic Surgeon, Royal Free Hospital
Steven Cannon, Consultant Orthopaedic Surgeon, RNOH,

Aim of the presentation:
To share the clinical issues arising from treating the first upper limb ITAP (intraosseous transcutaneous amputation prosthesis) recipient.

Subject studied:
A 52-year-old female who sustained multiple injuries as a result of the July 7th 2005 bomb attacks in London.

Summary:

The clinical findings and background history will be presented. The issues of an ipsilateral frozen shoulder and osteoporosis of the target long bone had to be addressed pre ITAP insertion. The goal setting process and initial outline treatment plan will be explained. The clinical challenges of post-operative oedema, protecting the skin adjacent to the implant, and the early mobilisation and loading programme will be discussed and illustrated. Initial 'use' of the cosmetic hand will be shown. This was then followed by preparation for and subsequent training with, her first functional (myoelectric) hand. She achieved very pleasing function and aspects will be demonstrated. The recipient's reactions, perceptions and aspirations will also be shared.

Conclusions:

This fascinating challenge has presented new clinical issues requiring innovative solutions. We are pleased to share this initial experience for the benefit of future recipients and the teams that may treat them.

Reflective Notes

Title: **Prosthetic management of a transhumeral amputee with an ITAP insertion**

Presenter: Nancy Pretty, Prosthetist, Mrs

Contact: Limb Fitting Centre
Royal National Orthopaedic Hospital
Brockley Hill
Stanmore
HA7 4LP

Tel: 020 8954 5024
Fax:
Email: stpros@blatchford.co.uk

Other Authors: Dr Linda Marks, Consultant in Rehabilitation, RNOH Stanmore
Morven McAlinden, Senior prosthetist, CA Blatchford, Stanmore DSC
Katrina Orme, Clinical Engineer, Stanmore Implants Worldwide
Joy Rendell, Clinical Specialist Occupational Therapist, RNOH Stanmore

This presentation details the provision of prosthetic componentry to a transhumeral amputee with an intraosseous transcutaneous amputation prosthesis (ITAP) implant. The objective of the prosthesis was to restore as much function as possible to the patient.

Having successfully completed the implant surgery, a comprehensive plan was drawn up to gradually increase the loading on the ITAP implant. Additionally a special fail-safe mechanism was manufactured by Stanmore Implants Worldwide to protect the implant from excessive stress. The fail-safe was attached directly to the external element of the ITAP proximal to the prosthetic componentry. The next stage of the treatment composed of gradually adding endoskeletal componentry until the patient felt comfortable wearing a full endoskeletal arm with cosmetic adult sized hand. Subsequently the prosthetic team added supplementary weight in small increments to the patient's arm so that the patient could become accustomed to the additional weight of a MK14 elbow. The endoskeletal elbow, and additional weight, was then replaced with the MK14 elbow.

To further increase function, a myoelectric hand was fitted after extensive myo-testing and training. The patient very rapidly became proficient with her first functioning hand. The MK14 elbow was then replaced with an ERGO elbow to provide a dampening effect because of the reported feeling of terminal impact with elbow extension.

The patient is currently undertaking a week long trial of the i-LIMB hand to understand whether it will improve her activities of daily living.

The progressive evolution of the componentry, together with the input of an occupational therapist has allowed the patient to feel comfortable with her prosthesis and enable her to perform daily activities. for the first time. She is a firm advocate of the advantages of her 'clip and go' arm. Further progress is expected as the patient continues with her rehabilitation.

Reflective Notes

Title: **The role of physiotherapy within the management of patients with upper limb loss or absence in a regional rehabilitation centre in the United Kingdom**

Presenter: Mary Jane R Cole, Physiotherapist

Contact: Roehampton Rehabilitation Centre
Queen Mary's Hospital
Roehampton Lane
London
SW15 5PN

Tel: 0208 487 6042
Fax: 0208 487 6907
E-mail: maryjrcole@aol.com

Introduction and aim

Historically, therapy input to patients with upper limb loss or absence has been predominantly the responsibility of occupational therapists. Despite British Society of Rehabilitation Medicine recommendations for physiotherapy in the post-amputation phase (BSRM, 2003) there are no national physiotherapy standards of practice for this group of amputees. The little literature available with reference to physiotherapy is in relation to the management of over use injuries only (Jones et al 1999).

In 2005 a regional questionnaire survey identified varying physiotherapy practices, referral patterns and different perceptions by the MDT of the physiotherapist's role in the management of this group of patients. Findings indicated that there is a role for physiotherapy and recommendations were made for each Centre (participating in the survey) to introduce and establish standards based on the findings and in relation to local needs and resources. The presence of local standards would guide clinical practice, facilitate audit and service development.

The aim of this paper is to outline the standards established for physiotherapy practice (following the survey) for upper limb patients attending Queen Mary's Hospital, Roehampton and illustrate examples of practice and initiatives that reflect subsequent development and audit findings.

Method

Retrospective audits of all primary upper limb amputees – adult and paediatric; all levels other than digit loss – attending Roehampton Rehabilitation Centre were performed with reference to the local standards. Established (i.e. those who have completed their initial period of prosthetic rehabilitation) amputees referred to physiotherapy during these periods were also audited.

Findings

The recommended standards for physiotherapy practice at Roehampton were mostly met i.e. an increasing number of amputees with upper limb loss or absence referred to the Centre are routinely seen by a physiotherapist at some stage in the period of prosthetic rehabilitation, frequently at or shortly after the first appointment. Established amputees who present with musculo-skeletal or pain related problems are referred for a physiotherapy assessment. Areas for improvement within the service were identified e.g. how and where physiotherapy interventions are documented for example.

Discussion and conclusion

The initial evaluation of physiotherapy provision to patients with upper limb loss or absence prompted local standards for clinical practice. A proactive approach has been taken by the MDT at a regional Centre to implement local standards and a key role for the physiotherapist is becoming established and affirmed through audit. The role of physiotherapy has contributed positively to an holistic approach to patient assessment, prosthetic prescription and rehabilitation.

Whilst teams need to consider the clinical and cost effectiveness of the physiotherapist being a core member of the UL MDT, the author believes it would now be helpful to evaluate national practice and physiotherapy outcomes with a view to devising national standards to guide best practice.

References:

British Society of Rehabilitation Medicine. 2003. Amputee Rehabilitation: Recommended Standards and Guidelines. BSRM http://www.bsrm.co.uk/Publications/Publications.htm.

Jones LE, Davidson, JH.1999. Save that arm: a study of problems in the remaining arm of unilateral upper limb amputees. Prosthetics and Orthotics International. 23. 55-58

Reflective Notes

Title: **Clinical Gait Analysis of Upper Extremity Amputees**

Presenter: Dr Denis RW May, Clinical Scientist

Contact: Kings College Hospital Rehabilitation Centre
Bowley Close
Farquhar Road
London, SE19 1SZ

Tel: 0203 049 7769 Fax: 02030497701

Introduction: To date the King's Gait Analysis Database has some 11,245 sets of clinical measurements on many patient groups. Measurements have been recorded on 1,329 patients ranging from 3.1 - 97 years of age; these include 702 Prosthetic patients (all levels), 278 Orthotic patients, 166 other Rehabilitation Patients as well as 183 'Normals' The above cases include 7 Upper extremity amputees who have been referred to assist in their prosthetic rehabilitation. Six of these patients were analyzed where the only difference between runs was walking 'With' or 'Without' their prosthesis. Two Patients were Trans Radial amputees. HL 46-year-old Female Congenital amputee wearing a R Cosmetic Arm. RS 52.4-year-old Male RTA amputee wearing a R Myoelectric Arm. Two Patients were Trans Humeral amputees. YT 32.7-year old-Female Congenital amputee wearing a L Cosmetic Arm. SE 51.5-year-old male Crush Injury amputee wearing a L Cosmetic Arm. Two Patients were Shoulder Disarticulation amputees. IA 25.8-year-old Male RTA amputee wearing a L Cosmetic Arm. DS 42.2-year-old Male Crush Injury amputee wearing a L Cosmetic Arm.

Method: Rigorous protocols are always adhered to such that comparisons between different runs and indeed different patients can be achieved. The Ground Reaction Forces GRFs were visualized to see if any differences could be found between walking 'With' and 'Without' their Prosthesis. The 'W' and 'WO' order of measurement was randomized to avoid any bias. The M/L GRFs of the Dominant Leg were compared to establish if there were any changes in M/L stability. The A/P and Vertical GRFs were also compared to establish if the natural energy exchanges due to the Arm Swings had any significant effect. Changes in the normal rotations and translations of the Trunk were observed during the analysis but not measured, but the Torsional stability was compared (Polar Rotation). The Foot Positional Accuracy for both the Dominant and the Ipsilateral Legs were compared and Fast Fourier Transformations FFTs computed to interrogate the Signature, note the Harmonics assess Balance and indicate the Stability of Locomotion.

Results: Dominance plays an important role in all normal and amputee locomotion, but in the upper extremity this is very much more significant and differences occur between Congenital and Acquired or Elective amputees. Differences were also found between Occasional and Habitual wearers. The results were also significantly effected by the Level of amputation, the higher the level the more marked the effect. As there was only 2 amputees at each level no meaning full statistics could be computed, but the trends are very good indicators. Generally the lateral stability improved when wearing the arm. The initial loading response at first rocker increased, and trunk rotations (torsional stability) improved. The velocity(v) power(W) and work done (J) all reduced on the dominant leg but was the same or increased on the ipsilateral limb, reducing the asymmetry. The FFTs showed marked reduction in amplitude in the lower frequencies indicating an improvement in positional stability in the coronal plane, but for the highest level (SD) where the arm-swings translate from the normal flexion-extension mode to an Ab-Adduction mode, this improvement, although seen in the coronal plane, was not seen in the saggital plane.

Conclusions: More patients need to be analyzed to statistically validate these initial trends.

References: May DRW (1998) Kinematic and Kinetic Analysis of Function. Chapter on Gait Analysis. *Sciences Basic to Orthopaedics,* edited by SPF Hughes and ID McCathy. WB Saunders & Co pp 277 – 296.

Reflective Notes

ABSTRACTS
(in order of presentation)

Tuesday 19 May 2009

Title: **Feet First**

Presenter: Frank Letch

Contact: REACH
PO Box 54
Helston
TR13 8WD

Tel: 0845 1306 225
E-mail: reach@reach.org.uk

This presentation will describe Frank's life and day-to-day activities in a fun, practical and down to earth way. He will demonstrate how he tackles a variety of tasks using his feet, from peeling potatoes to chopping an onion to answering his mobile phone. Frank is known for his informal style and lively interaction with the audience, encouraging questions and audience participation."

Reflective Notes

Title: **Elbows & Wrist Innovations to Advance Function**

Presenter: Harold H. Sears, PhD, President

Contact: Motion Control, Inc
115 N. Wright Bros Dr.
Salt Lake City, Utah 84116, USA

Tel: (801) 326-3434
Fax: (801) 978-0848
E-mail: Harold@UtahArm.com

Other Authors: Edwin Iversen MSME, Shawn Archer MSME, Tony Jacobs BSME

Re-developments for the Utah Arm were guided by direct clinical feedback, leading to the creation of advanced features for the "***U3+"*** prosthesis, as well as the "***Utah Hybrid Arm***".
The technical capabilities and approach of the existing Utah Arm system were used as a starting point, including:

- Strong molded plastic structures – with passive humeral rotation, and internal connection between all enclosed electronic components
- Efficient elbow lock
- Functional elbow range-of-motion, with freeswing at all positions
- Modular design, e.g., replaceable 12 v. battery, and field serviceable components

U3+ introduces design innovations improving wearer comfort and function, improving the ease of fitting with: unique Dual Locking System, Silent Freeswing, Wireless Bluetooth fine tuning (with hard-wire backup), and compatibility of all input sensors, and all TDs available.
The Utah Hybrid Arm design is practical for wearers with intact shoulder strength and ROM. Unique features include: automatic elbow locking, wearer-adjustable flexion assist, no-gap forearm cover, and reduced weight. The two systems are interchangeable on the same socket.

Wrist Components for Flexion, Adaptability, and In-Hand Pro/Supination:
Three wrist components have been developed, with the goal to increase function of myoelectric TDs:

1. Flexion/Extension Wrist, with manual reposition to three or four positions integrated into both hand and electric hook.
2. Multi-Flex Wrist, adds comfort and versatility to the Flexion/Extension joint with a spring-returned mechanism to the neutral position, from 30-degrees deflection in all directions. Reaction forces in the socket are reduced, and objects are gripped more securely that are moved through the work envelope by the TD. Locking in three positions is also provided, manually.
3. In-Hand electric wrist rotator. The high-torque and high-speed rotator (2x greater than earlier devices) gives the wearer greater manipulation force in active rotation, and quicker pre-positioning.

The evaluation survey of the Flexion/Extension Wrist and Multi-Flex Wrist has shown the functional pros & cons expressed by over 30 total wearers from a range of ages and amputation levels.

Key results from the survey include:

- wearer's rating of the naturalness, and comfort, of TD use with flexion wrist
- effect of wrist function on the activities performed
- ease of use of a TD with wrist function

Reflective Notes

Title: **Doctor, why can't I have an i-Limb?**

Presenter: **Dr S.Sooriakumaran, Consultant in Rehabilitation Medicine**

Contact: Roehampton Rehabilitation Centre
Queen Mary's Hospital
Roehampton Lane
London, SW15 5PN

Tel: 0208 487 6800
Fax: 0208 487 6805
E-Mail: ssoori@wpct.nhs.uk

Aim:
To share the experience of prescribing expensive special components, not available via the NHS.

Introduction:
Prosthetic devices such as electric elbows and i-Limbs would be considered too expensive to be supplied through service level agreement by most NHS centres. The only mechanism available is to

make a robust enough application to the PCT commissioning panel responsible for exceptional treatment. This panel of clinicians and managers would expect adequate clinical information of the patient, justification for the supply of special product, and published evidence of success of the particular product.

Roehampton practice:
At Roehampton, we have been successful in securing funding for number of such products. The majority of these applications have been for lower limb prosthetic products. In the case of upper limb prosthetics, two bilateral amputees have been successful in getting i-Limbs and a unilateral amputee an Otto Bock electronic elbow.

Methodology:
The patients would expect the treating team to be well informed of innovations in the field. It is important for the team to be proactive in learning the clinical advantages and technical features of the product and develop a criteria based on sound clinical principles. In contrast to other branches in medicine, there is hardly any robust published evidence in peer reviewed literature to support prescription of most prosthetic components.

Summary:
Experience of securing funding for special products & the present commissioning structure will be presented.

Reflective Notes

Title: **Properties of goal-directed movements with upper extremity prostheses**

Presenter: Hanneke Bouwsema, Researcher

Contact: Center for Human Movement Sciences
University of Groningen,
University Medical Center Groningen, sector F
P.O. Box 196
NL – 9700 AD Groningen
The Netherlands

Tel: + 31 50 3632710
Fax: + 31 50 363 3150
E-mail: H.Bouwsema@rug.nl

Other Authors: Corry K. van der Sluis, MD, PhD, Centre for Rehabilitation, University Medical Center Groningen
Raoul M. Bongers, MSc, PhD, University of Groningen, University Medical Center Groningen

Objective
After an amputation of the upper extremity, there is a huge loss of functionality such as reaching and grasping, which are essential actions in our activities of daily living. An upper extremity prosthesis is often used to restore the functionality for as best as possible. However, despite all technical developments, the rejection rate of prostheses is still high (Biddiss and Chau, 2007). The use of prostheses is often studied, but almost solely by means of questionnaires, while there has only been scant attention to how people actually handle their prosthesis in daily life. This is remarkable, given the fact that much is known about

movements of sound arms and hands. Describing the characteristics of movements made with a prosthesis could contribute to our comprehension of motor control processes underlying those movements. These insights could be a lead to further research for improving the design and the learning to use upper extremity prostheses. The aim of this study was therefore to characterize movement patterns of prostheses during goal-directed movements.

Methods
Six experienced users of upper extremity prostheses participated in the study; 3 men with a hybrid prosthesis—a mechanical elbow coupled with a myoelectric hand—and 3 women with a myoelectric forearm prosthesis. Three different tasks were examined, direct grasping, indirect grasping and reciprocal pointing. These tasks were chosen because these goal-directed movements are basic functions of an upper extremity. Position measurement systems were used to determine kinematics of the movements. Graphical and statistical analyses were carried out on the kinematic profiles.

Results
In the grasping tasks, the velocity profiles of the reach were asymmetric for both types of prostheses. In the aperture profiles, a plateau was present between hand opening and hand closing. There was also a decoupling between the reach and the grasp, that is, the reach was often already terminated before the hand closed around the object. Differences were observed between the hybrid prostheses and the forearm prostheses. Overall, the hybrid prostheses required more time to execute the movements, which were less smooth, more asymmetric, and showed more decoupling between reach and grasp. Results of the pointing task showed that an increase in task difficulty resulted in less harmonic movements in both types of prostheses.

Conclusions
Differences between the two types of prostheses mainly seemed to stem from difficulties controlling both hand and elbow with the hybrid prostheses compared to controlling just the hand of the forearm prosthesis. Compared to able-bodied behavior known from literature, the most outstanding differences was the presence of a plateau phase in the aperture of the prostheses. This characterization of movements with prostheses pinpointed specific deviations between different types of prostheses and between prostheses and able-bodied behavior. Rehabilitation and developments in technology should focus on control of the elbow in hybrid prostheses and on learning to coordinate reaching and grasping in myoelectric controlled devices.

Reference
Biddiss EA, Chau TT. 2007. Upper limb prosthesis use and abandonment: A survey of the last 25 years. 31: 236-257

Reflective Notes

Title: **The Assessment of Capacity for Myoelectric Control: development of standardized activities**

Author: Helen Lindner, MSc, Occupational Therapist, Mrs.

Presenter: Liselotte N Hermansson

Contact: Box 1613
Centre for Rehabilitation Research
701 16
Örebro, Sweden

Tel: +46-19-6025882
Fax: +46-19-6025881
Email: helen.lindner@orebroll.se

Other Author: Liselotte N Hermansson, PhD, Senior Occupational Therapist, Centre for Rehabilitation Research

Aims and Objectives

The *Assessment of Capacity for Myoelectric Control* (ACMC) is a clinical observational assessment designed to evaluate the client's ability in using an upper limb myoelectric prosthetic hand. Although the reliability and validity of ACMC were demonstrated earlier using client-chosen activities (1, 2), some ACMC raters expressed the need for bimanual activities that are standardized with ACMC items. This is to assist the identification of ACMC items and the evaluation of client's status in follow-up assessments. Hence, the aim of this study was to develop standardized activities with ACMC items.

Methods

The procedure consisted of two stages. The first stage was to ask the ACMC course participants (n=52, males=5, females=47) to suggest three activities that they normally use in training or assessment.

The second stage was to select several activities and standardize them with ACMC items. The selection was based on i) the hand movements required in the activity, and ii) the ACMC items. The items focus on six aspects: with/without arm being supported, gripping/holding/releasing in different positions/timing, with/without visual feedback, repetitive movements, adjusting speed/force and hand co-ordination.

Result

A variety of activities were suggested (Table I). One popular category is household activity. This indicates that the device is being used often in household activities. Another popular category is construction tasks and hobbies.

One task selected was "packing suitcase" because all the ACMC items are easily observed in this activity. One part of this activity was standardized as followed:

Taking the clothes from the wardrobe and fold them:

- Gripping/holding/releasing without support (3 items)
- Gripping/releasing in different positions (2)
- Timing during gripping/releasing (2)
- Hand co-ordination during gripping/releasing (2)

PADL	**IADL**	
Self-caring	**Household**	**Construction/hobby**
• Dressing	• Changing car tires/car oil • Installing smoke alarm • Grocery shopping/using wallet • Stocking groceries in shelves • Making simple meals • Changing bed • Dishwashing • Ironing • Hanging laundry • Washing small laundry items • Packing suitcase • Setting up curtains	• Making clipboard, birdhouse, coat rack. • Painting • Hanging up pictures • Sewing • Fishing • Repotting plants • Pitching a tent • Wrapping gift • Making handcraft • Playing doll dress-up

Table I: Activity suggestions

Recommendations
Once the selected activities are standardized, the evaluation of the validity of these activities to the ACMC is recommended. This is to ensure the activities are clinically valid and useful for the assessments in upper extremity prosthetics.

References

1. Hermansson LM, Bodin L, Eliasson AC. Intra- and inter-rater reliability of the assessment of capacity for myoelectric control. J Rehabil Med 2006;38(2):118-23.
2. Hermansson LM, Fisher AG, Bernspang B, Eliasson AC. Assessment of capacity for myoelectric control: a new Rasch-built measure of prosthetic hand control. J Rehabil Med 2005;37(3):166-71.

Reflective Notes

Title: **Case study illustrating multi disciplinary team working to achieve powered wheelchair control for a patient with a spinal injury and upper limb amputation**

Presenter: Karen Cook, BA, Dip. COT, MBAOT, Occupational Therapist

Contact: Prosthetic Centre
Disablement Services Centre
Southmead Hospital
Westbury on Trym
Bristol, BS10 5NB

Tel: 0117 9595703/14
Fax: 0117 9595730
email: Karen.cook@nbt.nhs.uk

The presentation is a case study, exploring an alternative method to chin control for controlling a powered wheelchair. The study is of a female adult with a spinal cord injury at level C4/5 and a left trans-humeral amputation.

Background
Mrs. C was assessed by the OT and engineer from the Environmental Control Service (ECS) in April 2008. This home assessment prompted a wider discussion about methods of wheelchair control and prosthetic provision. The OT works in both ECS and prosthetics, with a background in wheelchair services. Mrs.C controlled her powered chair with a chin switch, which was unsatisfactory because of neck pain, interference with social interaction and poor aesthetics. Mrs. C had some return of movement in her left shoulder. She was keen to explore possible options for using this movement to control her wheelchair. She was also keen to be provided with a cosmetic prosthesis.

Process
A series of assessments took place in Bristol from May 2008 until December 2008. The assessments involved the OT, prosthetist, EC engineer, rep from the wheelchair company, and Mrs. C's private physiotherapist. Different options were tried for socket type, position of controller and interface between the two. It was decided that a locking gel liner (OWW Alpha), was the most successful as it was relatively easy to don/doff by the carers, provided good suspension, it did not cause any skin problems and it allowed the interface to be fitted close to the end of the stump. It also provided adequate control without the need of a socket. The interface between the end of the stump and the ball controller was achieved with an adapted driving cup unit. Mrs. C was also supplied with a short cosmetic forearm attached to the wheelchair armrest to be used whilst driving the chair with her arm.

Present situation
Mrs.C is learning more reliable wheelchair control using this method but she can still swap to chin control when needed. The ECS has been integrated into the wheelchair controls with a separate system for use from her bed

The future

- Continue learning more reliable wheelchair control with this method
- Explore the possibility of using myoelectric sites as an alternative method of wheelchair control
- Provide a full length cosmetic limb for use with her manual wheelchair

Implications of this work

- It stresses the need for close multi disciplinary team working within the NHS and private sector
- It highlights the need to look holistically at each patients needs
- It reinforces how important aesthetics can be for someone who is severely disabled and fully dependent on technology for their independence.

Reflective Notes

Title: **Home modifications/adaptations**

Presenter: Christina Ragnö, OTR

Contact: Center for Arm Amputees
Red Cross Hospital
Box 55971
102 16 Stockholm
Sweden

Tel: +46 8 7911533
Fax: +46 8 106332
E-mail: armprotesenheten@rks.se

The presentation will include several examples of home modification/adaptations in kitchen for patients with multiple limb disabilities. Pain is a daily part of many of our patient's lives. As occupational therapists we analyse how to reduce this pain with for instance improved ergonomics, and make activities of daily living easier. Our experience is that home modification/adaptations is an important part of this.

Reflective Notes

Title: **Identifying the outcomes of upper prosthetic limb rehabilitation and their predictors: The Patients' and Rehabilitation Professionals' perspective.**

Presenter: Sinead NiMhurchadha, PhD student.

Contact Address: School Of Nursing,
Dublin City University,
Glasnevin,
Dublin 9, Ireland

Tel: 0035317008527
Email: sinead.nimhurchadha@dcu.ie

Other Authors: Dr. Pamela Gallagher, Senior Lecturer in Psychology, School of Nursing, Dublin City University.
Prof. Malcolm MacLachlan, Professor of Psychology, Dept. Of Psychology, Trinity College Dublin
Dr. Brian O'Neill, Clinical psychologist, WESTMARC, Southern General Hospital, Glasgow.

Purpose: The aim of this study was to explore the outcomes and predictors that individuals with upper limb absence and the rehabilitation professionals consider important in relation to upper limb prosthetic rehabilitation and to compare and contrast these two groups' perspectives.

Method: Two focus groups with seven participants and four individual interviews were conducted with individuals who have upper limb absence. In addition, face to face and telephone interviews were conducted with nine upper limb rehabilitation specialists. The data were analysed via thematic analysis.

Results: The main outcomes identified from all analyses were concerned with satisfaction with functional abilities, satisfaction with prosthetic device; involvement in activities of daily living, leisure activities, work activities and participation in original roles, such as breadwinner. The service providers also considered wearing the prosthetic device to be an important outcome. The predictors both groups identified in common to be related to a successful outcome following rehabilitation of upper limb loss consisted of having acceptance of limb loss, social factors, such as social support, issues with the prosthetic, and service related factors. Both groups emphasised the importance of the Occupational Therapists and psychological support. In general, the service providers had a greater emphasis on amputation related factors such as the cause of amputation and the physical state of the limb, whereas, patients were more concerned with the skills they employed to cope with limb loss, such as having a positive attitude, motivation to achieve goals and downward social comparison.

Conclusions: This study provided a forum for patients and rehabilitation professionals to voice their opinions in what they believe to be the outcomes and predictors involved in successful rehabilitation. Given that the predictors identified were not purely physical predictors, this research emphasizes the need for rehabilitation to equip each patient with the personal and social skills, along with the functional skills, to engage meaningfully in all aspects of life following limb loss. It is essential that the different perspectives are understood in order to satisfy the patients needs while using the multidisciplinary teams experience to maximise 'optimal outcomes' for individuals with upper limb absence.

Reflective Notes

Title: **Creating an informational interactive DVD resource for Children with congenital limb deficiency and amputations through Audit and Patient and Public Involvement (PPI).**

Presenter: Lisa Kirby, 5th Year Medical Student, Miss

Contact: Specialist Mobility Rehabilitation Centre,
Preston Business Centre
Watling Street Road
Fulwood, Preston, PR2 8DY

Tel: 01772 523853
E-mail: Fergus.Jepson@lthtr.nhs.uk

Other Author: F K Jepson, Consultant in Rehabilitation Medicine, Dr
Lancashire Teaching Hospitals NHS Foundation

The aim was to create an information resource that would be accessible to a child (who had either a congenital limb deficiency or was due to undergo / had undergone an amputation), their families and carers. The information resource needed to be interactive, audiovisual and engaging so as to provide information to the child, family and carers that covered the prosthetic multidisciplinary team, their roles and what to expect.

A DVD menu system was developed using DVD Studio Pro because of the high level of accessibility to DVD players and computers in the home, allowing for viewing in the patients own home: a safe and comfortable environment for the patient.

A member from each of the disciplines initially wrote the information that they felt was pertinent. This information was then reviewed and reinterpreted for the younger and older aged child. The menu system allows for 2 levels of information to be presented, the first is short and brief for the younger child and the second level is for the parents and older child, the hope is that this will allay fears, engender some familiarity with the multidisciplinary team and stimulate discussion at home. Cartoon drawings were then created and altered to be child friendly. Videos were taken of certain activities (physio, casting and myotraining). The texts were re-verified and the DVD complied.

Audit: To ascertain that the content was age appropriate an audit was undertaken involving a local school with which the unit had links. The questionnaire was created that was specific to all aspects the DVD and the overall impression of the informational content, appropriateness of the images and ease of use.

Method: The Head teacher and class teachers were provided with the DVD and questionnaire for review. The school made their computer room and classes (age range 10-12) available.

The children were brought into the computer room and the DVD started. The auditor was present to provide help and this was noted if needed. The children filled out the questionnaire as they reviewed the DVD.

Results: high satisfaction scores were recorded and areas for improvements were limited to individual comments. 100% of children were able to access all the information and the comments included: 'Now I know if I lose one of my legs there will be people to help me' and 'if I lose a leg now I know I will be fine'.

Results were presented to the trust Patient Information Group and minor adjustments were made to the disclaimer.

Conclusion: our aim is to make this 'non-profit' DVD available to all clinicians and centres across the UK and to include a range of non-English language versions to meet the diverse cultural needs of our service users and carers. Plans are in progress to make it available as a resource on the trust website. We are in the process of creating an adult version.

Reflective Notes

Title: **Family picnics with children after upper limb amputation**

Presenter: Darinka Brezovar, OT

Contact: Institute for Rehabilitation
Linhartova 51
1000 Ljubljana, Republic of Slovenia

Tel: 386 (0) 1 4758 100
Fax: 386 (0) 14376 589
E-mail: darinka.brezovar@ir-rs.si

Other Author: Helena Burger, MD, PhD, Institute for Rehabilitation, Republic of Slovenia

Aims and objectives: The main rehabilitation goals of children after upper limb amputation are to become productive, independent with and without prosthesis and to have satisfying lives. An important member of a rehabilitation team treating those children is an occupational therapist. Occupational therapy is usually performed individually, however, it can also be organized in groups. Individual therapy is more appropriate immediately after the first prosthetic fitting and after being fitted with a new system when a child has to concentrate and follow instructions. Later on, at follow-ups, group activities can be added, where children and parents get to know each other and see that there are many other people in the same boat. At Institute for Rehabilitation in Ljubljana, we used cooking and organized picnics, where different outdoor games were played.

The aim of the present study was to find the children's and parent's opinions about the picnics.

Methods and Subjects: A questionnaire about picnics was prepared and sent to all (n=11) the families visiting our outpatient clinic for rehabilitation of children after upper limb amputation who participated in at least one picnic.

Results: Three picnics were organized in three consecutive years. Each time all the children visiting our outpatient clinic (24) were invited together with their families. The first year, 11 families (45 participants all together) attended, the second year 9 families (36 participants) and the third year 8 families (30 participants). The fourth year only six families responded to the invitation and the event was cancelled. We believed that one of the reasons for that was that during those four years there were no new children with upper limb amputation in Slovenia and the ones already visiting us grew older.

All the picnics were organised at a playground. The children played on a slide and swings, climb on a jungle gym , played with sand and balls, and jumped rope. At the end, some food was served so that the children had to unwrap ice creams, open juices or peel fruits, Many children performed most of those activities without prostheses.

Five correctly filled-in questionnaires were returned. The subjects considered the picnics well organized and most of them would attend them again. About a half of those who did not answer the questionnaire were 18 years old or older. The other half of those who did not answer were children who were too young to participate actively in most group games. Their parents seemed to have participated mainly to meet other parents.

Conclusion: It can be concluded that the picnics served as a social event that offered the children to spend some time with other children and their parents as well as with rehabilitation team members in an informal setting.

Reflective Notes

Title: **Training with cosmetic prosthesis**

Presenter: Maria Nilseryd, Occupational Therapist

Contact: Red Cross Hospital
Box 55971
102 16 Stockholm
Sweden

Tel: +46 8 791 15 33
Fax: +46 8 10 63 32
E-mail: maria.nilseryd@rks.se

At the Red Cross Hospital in Sweden we train our patients, not only with functional prosthesis, but also with cosmetic prosthesis. At the start of the treatment we ask the patient to list activities that they find difficult or impossible to carry out, but that they want to be able to accomplish. The patient together with the Occupational Therapist negotiate targeted outcomes and develop an action plan. The patient's goals and needs are always central. Since the patients that choose a cosmetic prosthesis often have a high demand of cosmetic appearance, the first training session often revolves around making the patient look as natural as possible using the prosthesis. This can be walking with the prosthesis, sitting down, standing up etc. In the rehab process we try to make the patient aware of the use of the prosthesis not only as a support but also the possibility for grips such as holding a fork while cutting with the other hand or as a way of holding for example a notebook. By training our cosmetic prosthesis users in daily activities they can achieve as much independence as possible in activities that are important to them.

Reflective Notes

Title: **Clinical Experiences of Mirror Training**

Presenter: Christina Ragnö, OTR

Contact: Center for Arm Amputees
Red Cross Hospital
Box 55971
102 16 Stockholm
Sweden

Tel: +46 8 791 1533
Fax: +46 8 106332
E-mail: armprotesenheten@rks.se

As Occupational Therapists at the Center for Arm Amputees at the Red Cross Hospital, Stockholm, Sweden, we see about 40 to 50 new arm amputees every year. Phantom pain is part of their everyday life. Resently we have been asked to treat also patients with plexus injuries - mainly their problems with phantom pain. Since some years we have used the Mirror Box training.

Two patient cases will be presented; a woman with below elbow amputation caused by a tumor, and a man with a traumatic plexus injury after a bicycle accident.

Pain was mapped in a "Pain Diary", where the patient registred the pain several times a day. Together with the patient we then tried to find pain patterns and what had influenced the pain.

The Mirror training was carried out by teaching the patient how to use the mirror three times per day for a period of four weeks.

The result shows that pain could be reduced this way.

Reflective Notes

Title: **EX-Center, Team approach**

Presenter: Anita Stockselius, OTR, Christina Ragnö, OTR

Contact: EX-Center
Red Cross Hospital
Box 55971
102 16 Stockholm
Sweden

Tel: +46 8 791 1533
Fax: +46 8 106332
E-mail: armprotesenheten@rks.se

EX-Center is a National Knowledge and Rehabilitation centre (Centre of Excellence) for children and adults with multiple extremity deficiencies. Our target groups are Thalidomide victims, people born with congenital malformations (Dysmelia), and people with amputations, whether the cause is trauma, tumour or another disease for instance sepsis which is something we see more of today. The Centre started as a project in 1993, and is a unique collaboration between the Swedish Thalidomide Society NGO and the Red Cross Hospital. The team includes medical doctor, physiotherapist, occupational therapist, coordinator, psychologist, social worker, information officers and administrative staff. Some of the team members have personal experience of living with multiple extremity deficiencies and act as role models. Ex-Center treats patients from Stockholm as well as patients from other parts of Sweden and other countries.

Reflective Notes

Title: **The Ultimate Challenge**

Presenter: Kristin Gulick, OTR/L, CHT

Contact: 63541 Saint Cloud Court
Bend, OR 97701
USA

Tel: (503) 310 1524
E-mail: kristingulick@gmail.com

Background
We all have opinions about what the greatest challenge is when working with a client with upper limb loss. For many of us the challenges vary based on the client, the technology available, the funding available, and the environment.

Focus
Our individual professions direct our focus on challenges within our areas of expertise. Today's challenges include improving technology, providing appropriate technology for the client, utilizing reliable and valid tools to measure effectiveness, providing effective training, and often finding funding for rehabilitation.

But what is the Ultimate Challenge?

Reflective Notes

ABSTRACTS
(in order of presentation)

Wednesday 20 May 2009

Title: **Management of transhumeral amputation and contralateral hemiplegia in a child.**

Presenter: Dr E McGilloway, Specialist Registrar in Rehabilitation Medicine

Contact: Roehampton Rehabilitation Centre
Queen Mary's Hospital
Roehampton Lane
London, SW15 5PN

Tel: 0208 487 6800
Fax: 0208 487 6805
E-mail: emcgilloway@doctors.org.uk

Other Author: S.Sooriakumaran, Consultant in Rehabilitation Medicine

<u>Aim:</u>
To highlight the complexity of prosthetic management of a child with profound sensory and physical impairments.

<u>Clinical details:</u>
GM, a 7-yr-old male had a perinatal LMCA infarct (resulting in right dense hemiplegia) and left axillary vascular occlusion necessitating trans-humeral amputation at 9 days old. GM was born at full-term by emergency caesarean section.

<u>Right hemiplegia:</u>
Vision – right-sided field defect
Speech – able to comprehend & vocalise
Right upper limb – spastic, treated with second skin now able to feed
Right lower limb – delayed walking. Uses HAFO
Behaviour – ?autistic spectrum
Education – school for special needs with statementing

<u>Left transhumeral amputation & prosthetics:</u>
Satisfactory length, myoplasty and active shoulder movement.
First passive prosthesis: At 10 months – not successful.
First functional prosthesis: At 21 months. Electric SCAMP hand, self-suspending sleeve and ratchet and friction elbow. Switch operated by shoulder movement pulling an op cord.
Bone overgrowth – warranted three surgeries.
At present fitted with mechanical hand with Iceross ratchet suspension operated by carers.

<u>Summary:</u>
- Demanding issues of managing high level amputation with concurrent contralateral hemiplegia & visual impairment in a developing child will be demonstrated.
- Video clips of child's development and hand functions will be demonstrated.
- Management of bone overgrowth will be highlighted.

Reflective Notes

Title: **Rehabilitation of a patient with bilateral amputation due to epidermolysis bullosa – a case report**

Presenter: Matej Burgar, CPO

Contact: Institute for Rehabilitation
Linhatova 51
1000 Ljubljana
Republic of Slovenia

Tel: 386 (0) 1 4758 100
Fax: 386 (0) 1 4376 589
E-mail: helena.burger@ir-rs.si

Other Authors: Maja Mkakar, CPO, Institute for Rehabilitation, Republic of Slovenia
Helena Burger, MD, PhD, Institute for Rehabilitation, Republic of Slovenia

Aim and objective: Epidermolysis bullosa (EB) is a rare genetic disease characterized by the presence of extremely fragile skin and recurrent blister formation, resulting from minor mechanical friction or trauma. An estimated 1 out of every 50,000 live births are affected with some type of EB. The disorder occurs in every racial and ethnic group throughout the world and affects both sexes equally (http://www.debra.org).

In EB, even slight friction can produce blisters, so minimal and gentle handling is absolutely necessary. A cool environment, avoidance of overheating, and skin lubrication to reduce friction can help lessen blister formation.

The aim of the present paper is to present rehabilitation of a patient who had transradial amputation on one side and finger deformations on the other due to EB.

Methods: The patient was examined at the outpatient clinic of the Institute due to problems with many daily activities. Team solutions were reached and follow-up visits were made at the patient's home.

Results: A sixty-two-year old lady with EB came to the outpatient clinic for the first time15 years ago, ten days after right trans-radial amputation due to spinocelular skin cancer. She had amputations of fingers on the left hand and quite good ROM in the left wrist. On both sides she had thin atrophic skin with many wounds, scabs and some blisters. She had skin problems on her feet, face and scalp. She wanted to be as independent as possible because she lived alone and also wanted to be able to do some gardening.

Due to the patient's skin problems and the EB, classic prosthesis was not considered to be useful for her. It would cover a great part of the damaged skin and place pressure on it as well as present problems with overheating especially in summer. The patient was prescribed and fit with a custom-made wrist and hand orthosis for the left side. With the orthosis the patient is independent in most basic and instrumental daily activities as well as gardening. She is satisfied with the outcome.

Conclusions: When deciding about rehabilitation and a proper prosthesis or other devices it is necessary to take into account all medical problems as well as patients' wishes. The article relates how all of those were successfully considered in a case of a patient with a rare medical condition of EB.

References: http://www.debra.org/EB/index.php

Reflective Notes

Title: **Functioning with a congenital reduction deficiency of the upper extremity: the role of adaptations**

Presenter: Dr. Iris van Wijk, rehabilitation physician, Mrs

Contact: Rehabilitation Centre De Hoogstraat
Rembrandtkade 10
3583 TM Utrecht
The Netherlands

Tel: +31 30 2561329
Fax: +31 30 251 1344
E-mail: i.v.wijk@dehoogstraat.nl

Other Authors: Bert Marlet, Adaptation Technician, Marie-Louise Vestjens, OT
RC De Hoogstraat, Utrecth, Netherlands

In the Netherlands each year about 70 children are born with a congenital reduction deficiency of the upper extremity, of which 14 children have a transverse deficiency of the upper limb. In rehabilitation centre The Hoogstraat these children and their parents are seen at regular intervals by a team which consists of a physician, a physiotherapist, an occupational therapist, a social worker, a prosthetist, an adaptation technician, a remedial educationalist, and a research scientist.

The main objective for the team is to inform the parents about the functional prognosis of their child and the different treatment options. This includes advice on the benefits and disadvantages of wearing a prosthesis. When the child encounters a restriction in activities there are three strategies to overcome this restriction. First, the child can choose a different way of executing the required task, which we call “compensation”. Second, a prosthesis might be beneficial. And third, different kinds of aids can be used.

The prosthesis is supposed to enhance function, but in practice we found that a lot of prostheses are not used the way they are designed for and rejection rates are high.

A few years ago we interviewed all children that were under our care in that year about the prescription and continued use of a prosthesis. Out of the 230 children 68 had ever been prescribed a prosthesis. However, only 26 patients still use their prosthesis at the time of the interview.

Apart from the prosthesis, which has a generic grasp and support function, we make many adaptations, i.e. custom-made prostheses for specific functions like eating, playing sports, and playing an instrument.

We asked the same 230 children about their use of adaptations and 95 used one or more of these adaptations. In this group a total of 215 adaptations were used.

In our presentation we will show several examples of the different types of adaptations. The adaptations are light weighted, cheap and easy to don and doff by the child itself.

In our opinion any of the three strategies can be successful and usually the child uses different strategies for different activities. It is important to select the solution that fits best to the child and its environment.

Reflective Notes

Title: **Custom-made silicone liner prosthesis for congenital infant: a case study**

Presenter: Vincent B MacEachen, Prosthetist

Contact: WestMARC
Southern General Hospital
1345 Govan Road
Glasgow, G51 4TF

Tel: 0141 440 1441
Fax: 0141 445 5035
E-mail: vmaceachen@hotmail.com

Due to changes in regional care there has been an increase in referrals of infants with congenital limb absence in upper limb to the Prosthetic Department, WestMARC. Traditionally such patients have been fitted with 1-piece cosmetic passive prostheses.

Suspension is critical for anupper limb prosthesis to perform satisfactorily. Usually one could expect to suspend a trans-radial socket from the olecranon or epicondyles. In cases where the elbow is not yet developed, such as a baby, this suspension option is not possible. An alternative option is a 2-way stretch sleeve, however to prevent the infant from self-doffing this type of sleeve would need to be tight, which can present difficulties. An appendage would be a viable suspension option for a baby but parents tend to be resistant to this approach.

The author has chosen to explore alternatives to the aforementioned suspensions. One option is the incorporation of a silicone interface with lanyard suspension. The author has utilised this method on patients at various stages of development.

This case study will present a child aged 9 months with a congenital trans-radial deficiency who was fitted with a custom-made silicone liner, lanyard suspension and passive hand. There is much to discuss with respect to the age of initial fitting, prescription, interface material and suspension. The case study will touch on these issues and discuss further the patient's outcome. Despite the long-term use of silicone in prosthetics and the extensive literature associated, the author believes this work to be useful because of the limited literature on the use of silicone in this way for congenital infants with upper limb deficiency.

Reflective Notes

Title: **Challenges of a Trans radial**

Presenter: J.R.Ronald Prosthetist FISPO. MBAPO. SRPros.

Address: 5, Kendal Drive,
Beeston,
Nottingham,
NG9 3AW.

Telephone: 01159254179
Fax: none
E-mail j.ronald452@btinternet.com

Patient is a 48 year old male who sustained a traumatic injury at his work place which resulted in an amputation of his left forearm he is right hand dominant.

The challenge was that Roger lived on his own, so he needed to be self sufficient. His main concern was being able to go back to work. He also had a few interesting hobbies he wanted to pursue. He still want play his guitar, compete in twelve bore shot gun competitions, continue to ride his motor cycle and have a realistic hand he could use.

Prosthesis supplied:-.

I Limb hand. Prosthesis to help playing a guitar. Prosthesis with appliance for twelve bore shooting and Motor Cycle riding.

Reflective Notes

Title: **Analysing the relationship between socket design and electrode contact with myoelectric prostheses functionality: A prosthesis user questionnaire**

Presenter: John Head; Prosthetist / Lecturer

Contact: Brian Blatchford Building
Frederick Road
University of Salford

Tel: 0161 295 2303 Email: J.Head@salford.ac.uk

Other Authors: G. Heath; M. Twiste; L .P. J. Kenney.

This study formed part of a series of investigations designed to assess the efficacy of current prosthetic interface (socket) designs and electrode housings with regard to myoelectric prostheses functionality. Currently, differential electrodes are used to provide the signal recognition capability within modern myoelectric systems. Crucially, differential electrodes rely on continuous and secure contact with the skin to operate effectively. Motion between the electrode and the skin, or a break in contact, may lead to false signal production and unwanted activation of the myoelectric hand[1]. Although it is widely accepted that movement between the electrode and the residuum, and indeed compromised myoelectric interface contact in general, will lead to a variant prehensor response, there is little actual data that directly links electrode contact, socket fit and prosthesis functionality.

This study involved the distribution of a carefully constructed questionnaire to known transradial myoelectric prostheses users, seeking information regarding their prosthesis usage rates, socket types and fit, and any problems with usage that they may have encountered that could be related to electrode contact problems within the socket. Information gathered was used to construct a data base of responses that could show if a definite and relative link between areas within the remit of socket design, electrode contact and prosthesis usage and functionality exists.

There were 24 respondents to the questionnaire, from a total of 40 that were originally sent out; a response rate of exactly 60%. The results suggest that there is a consistent problem with operation relating to false signal production and a failure or inability to fully control the myoelectric prehensor, and that this may be linked to the fit of the electrodes within the prosthetic socket and to the socket fit it self. Up to this point only a small number of service centres have been kind enough to offer their help with this study, although this number will be increasing shortly following an update to the questionnaire. It is hoped that the results from this study, together with others that are ongoing within the same area of interest, will help the evolution of myoelectric interfaces and lead eventually to greater levels of functionality for upper limb prosthesis users.

Reference:

1) Kampas P, *The optimal use of myoelectrics*. Translation of: Med. Orth. Tech 2001; 121; 21-7.

Reflective Notes

Title: **Changes in prehension over training with a myoelectric simulator**

Presenter: Raoul Bongers, Researcher

Contact: Center for Human Movement Sciences
University of Groningen,
University Medical Center Groningen, sector F
P.O. Box 196
NL – 9700 AD Groningen
The Netherlands

Tel: + 31 50 363 8867
Fax: + 31 50 363 3150
E-mail: R.M.Bongers@rug.nl

Other Authors: Hanneke Bouwsema, MSc, University of Groningen, University Medical Center Groningen
Corry K. van der Sluis, MD, PhD, Centre for Rehabilitation, University Medical Center Groningen

Objective
The rate of use of prosthetic devices that replace the arm after an amputation is generally low. The use of an upper limb prosthesis is not only determined by its function, the technical possibilities, but also by its functionality, the way the amputee is able to handle the prosthesis. It is known that training increases the functionality of prosthetic use, and, presumably, the motivation to use the prosthesis (Lake, 1997). However, what should be paid attention to in training so that functionality of prosthetic use increases? To answer this question we measured the changes in movement characteristics when participants learned to control a myoelectric forearm prosthesis. Describing the changes in movement characteristics over learning should allow us to determine where practitioners in rehabilitation should focus on. There is only a small number of recently amputated persons, so we had able-bodied participants learning to use a prosthetic simulator, to increase the reliability of our tests.

Methods
Nine right-handed participants participated in the study. All used a right-handed myoelectric simulator—with an Otto Bock Digital Twin hand—that mimicked the working and the performance of a real prosthesis used by amputee's (see Bouwsema, van der Sluis & Bongers, 2008). Three tasks were performed, which were all based on the way prostheses are used in daily life: (a) direct grasping, in which a cylindrical object was picked up with the simulator, (b) indirect grasping, in which the same cylindrical object was handed over from the sound hand

to the hand of the simulator, and (c) fixating, in which a ruler had to be fixated with the simulator while a line was drawn along the ruler using the sound hand. Each task was performed 20 times on two consecutive days. An opto-electric camera system measured the 3D position of active markers attached to the tip of the thumb, index finger, and wrist of the prosthetic hand.

Results

In the beginning of the learning the aperture profile in the direct grasping task showed a large plateau phase. This indicated that hand opening and hand closing were not following each other smoothly in time but that the hand remained open during a large part of the reach. Moreover, the end of the grasp was much later than the end of the reach, implicating that the enclosing of the object occurred after the hand had reached the object. Over learning, these two characteristic features of the prosthetic grasp changed; grasping time decreased due to a decrease of the duration of the plateau phase and the difference between end of reach and end of grasp became smaller. The data of the other tasks will be analyzed in the near future.

Conclusions

Our results showed that over learning the prehensile profile looked more like prehension of able-bodied hands: hand opening and hand closing became more coupled as did the grasping and the reaching. This suggests that practitioners should focus on these two aspects when teaching patients to learn to use a forearm prosthesis to grasp an object.

References

Bouwsema H., van der Sluis C. K., & Bongers R. M. (2008).The role of order of practice in learning to handle an upper-limb prosthesis. *Archives of Physical Medicine and Rehabilitation, 89,* 1759-1764.

Lake C. (1997). Effects of prosthetic training on upper-extremity prosthesis use. *Journal of Prosthetics and Orthotics, 9,* 3-9.

Reflective Notes

Title: **Effect of a multifunctional prosthetic hand on hand functioning, activity, and psychosocial adjustment**

Presenter: Liselotte Norling Hermansson, PhD, Reg OT, Mrs

Contact: Centre for Rehabilitation Research
Box 1613
SE 701 16 Örebro
Sweden

Tel: +46 19 602 58 75
Fax: +46 19 602 58 81
Email: liselotte.hermansson@orebroll.se

Other Authors: Christina Carlsson, Reg OT and Anders Amilon, Hand Surgeon, Department of Hand Surgery, Örebro University Hospital, Örebro, Sweden

Aims and objectives:

The development of multifunctional prosthetic hands such as the i-Limb hand is aimed at improvement of hand functioning and participation in everyday life. However, the functional outcome in persons who are fitted with the i-Limb hands has not yet been evaluated. The aim of the present paper was to report the outcome of i-Limb hand fittings in persons who are previously fitted with Otto Bock hands.

Methods:
Eight persons (5 males/3 females, median age 43/30 range 28-69 years) participated in this study. All females had congenital limb deficiency (2 right/1 left) and all males had acquired

amputation (3 right/2 left). Two men had bilateral amputation with an active prosthesis on the left and the right side, respectively. All participants except one male (part-time) were full-time prosthesis users. Before the study, they were using Otto Bock hand size 7 ¼" (females) and 7 ¾" (males). Prosthetic experience ranged from 10-35 (median, males 19/females 27) years.

Three outcome measures were used to assess the functional outcome of i-Limb. The *Southampton Hand Assessment Protocol* (SHAP) was used to measure hand function. To measure activity a self-rated questionnaire, the *Upper Extremity Functional Status* module of *Orthotic Prosthetic Users' Survey* (OPUS-UEFS), was used. Furthermore, two sections from the *Trinity Amputation and Prosthetic Experience Scales* (TAPES) part 1, the Psychosocial Adjustment and the Prosthesis Satisfaction scales, were used. In addition to these outcome measures, a study-specific questionnaire which focused on the experience of the i-Limb hand was administered.

Initially, the participants were assessed with their Otto Bock hand. After a four-week training and follow-up period, the participants were re-assessed using the same procedure. Wilcoxon Signed Ranks Test for two related samples was used to compare the SHAP and TAPES scores respectively. The t-test was used to compare the OPUS-UEFS scores. P-values < 0.05 were accepted as statistically significant.

Results:
All but one participant, who used the i-Limb hand only the whole time, used the i-Limb hand for around 3-5 hours and the Otto Bock hand for the rest of the day during the study period. The main reason for this was, according to the study-specific questionnaire, the lack of grip strength and the size (too large) of the i-Limb hand. The benefits of the i-Limb hand, as reported by the participants, were the unique hand movements such as the adjustable grip, the lateral pinch grip and the precision grip mode.

No significant difference was found on the SHAP index scores between the functions of the two hands. However, overall the grip scores were higher on the Otto Bock hand with significant difference on the Extension grip ($p=0.035$). There was no significant difference between the hands on the OPUS-UEFS but significant differences were found on TAPES Psychosocial Adjustment ($p=0.027$) and Prosthesis Satisfaction ($p=0.018$) scales, with scores in favour of the Otto Bock hand.

Conclusion:
The unique features of the i-Limb hand are promising. An improvement in the grip strength and the development of different hand sizes would increase the usefulness of the i-Limb hand.

Reflective Notes

Title: **Upper Limb Prosthetic Outcome Measures (ULPOM) Group**

Presenter: P.J.Kyberd, President's Chair in Rehabilitation Cybernetics

Contact Institute of Biomedical Engineering
University of New Brunswick
25 Dineen Drive
Fredericton, NB, E3B 5A3
CANADA

Tel: +1 506 453 4966
Fax: +1 506 453 4827
E-mail: adam.clawson@unb.ca

Other Authors: K. Gulick, OTR/L, CHT, Therapeutic Associates, Bend, OR, USA. Norling
L Hermansson, PhD, Reg OT, Centre for Rehabilitation Research, Örebro University Hospital, Sweden
W.Hill, BSc, OT(C), Institute of Biomedical Engineering, UNB, Canada

Background: There is currently an increasing desire to objectively measure the functional effectiveness of a prosthesis, the ability of a user with their device, or the impact of the device in daily life. The problem has been that there are many tools to measure the function of the upper extremity, but few are appropriate or validated for this population. Similarly, there is a lack of a common language to communicate professional judgement to colleagues.

What does exist is an array of different tools and there is little standardisation between centres in the same country, or across borders. In some situations to save time, or effort, fully validated tests are shortened, or favoured sub-tests are selected, so that the results obtained are incomplete, invalid, or simply wrong.

Evolution of an approach: It became apparent to many that there was a need to achieve greater knowledge and understanding of outcomes tools by practitioners and engineers who are engaged in this field. A series of meetings were held in Canada and Norway from 2005 [1]. At the World Congress of ISPO in August 2007, a broad working group, known as the Upper Limb Prosthetic Outcome Measures (ULPOM) Group, was formed. The group's aim is to produce recommendations in order to create a standardised approach and to engage a consensus within the professions.

One of the implicit aims of the group is not to invent another test to add to the tests that already exist, so the process they have adopted has been to identify those tests which are most appropriate for assessing prosthetic use; to judge which of these are already validated for use with prostheses, or to identify what is needed to validate them, and, in the long term, assist in the process of validation. From this, it is hoped that a toolbox of techniques and measures with a standardised approach to assessment will be evolved.

Assessment: The approach taken conforms with the World Health Organization International Classification on Functioning, Disability and Health (WHO-ICF) [2] which provides a standard language and framework for the description of health and health-related states. By this, it clearly expresses the different information domains that exist in the development of a healthcare product or service:

1/ Body structures and functions
2/ Activities
3/ Participation

It is expected that no single test can be used in all three domains, but at most across two, so that the group is identifying multiple tests for recommendation.

Progress: The ULPOM group have drawn up a list of tests that are approved and for tests with potential, identified the work that would enable them to become approved. They are also in the process of disseminating the information to the profession at venues such as TIPS.

References

1. Wright V. (2006) *Measurement of functional outcomes with individuals who use upper extremity prosthetic devices: Current and Future Directions* Journal of Prosthetics and Orthotics, 18(2), pp 46-56

2 World Health Organization Towards a common language for functionary, disability and health: ICF beginner's guide (WHO/EIP/GPE/CAS/01.3) WHO, Geneva, 2002.

Reflective Notes

Title: **A New Active Shoulder Prosthesis: From the Design to the First Clinical Application**

Presenter: Gruppioni E.[1], Chiossi M.[1,2], Troncossi M.[2], Cutti A.G.[1], Davalli A.[1], Parenti-Castelli V.[2]

Contact: [1] I.N.A.I.L. Prosthesis Centre, Vigorso di Budrio, Italy
[2] Dept. of Engineering, University of Ferrara, Italy

E-mail: ag.cutti@inail.it

INAIL and the Mechanical Department of the University of Bologna, have recently developed a prototype of a new 2-degree-of-freedom active shoulder. The new prosthetic component was conceived to overcome the limitations imposed to amputees by passive shoulder mechanisms, and was developed to be compatible with commercial battery-powered prosthetic joints. The development of the mechanism is the result of a rigorous approach, which made it possible to optimize the functionality and the wearability of the prosthetic device.

The articulation consists of two connected electrically-powered joints that actuate the spherical motion of the upper-arm, i.e. they allow the elevation of the upper-arm in any vertical plane passing through the shoulder centre of rotation.

The prototype underwent laboratory tests needed to evaluate the mechanism's performance (e.g. the actual maximum payload) and the electrical requirements (e.g. the current draining). Based also on the results retrieved from these tests, an on-board control-unit was implemented for the control of an entire upper-limb prosthesis. The control-unit can drive up to five motors and can manage different control strategies according to the amputees' preferences.

A prosthetic arm equipped with the new shoulder prototype and the on-board control-unit – along with a myoelectric elbow, prono-supination unit and hand – was tested by a patient with a first-proximal trans-humeral amputation. Results showed that some improvements are needed concerning the control strategy, the noise and the socket. However, they also showed that the new shoulder is really applicable in the clinical practice.

Reflective Notes

Title: **Feasibility of activity monitoring for upper limb prosthetic evaluation**

Presenter: M Sobuh, MSc, Mr.

Contact: Office PO23
Brian Blatchford Building
University of Salford
M6 6PU

Tel: 0161 295 0454
E-mail: m.m.d.sobuh@pgr.salford.ac.uk

Other Authors: Kenney L, PhD[1], Tresadern P, PhD[1], Thies S, PhD[1], Twiste M, PhD[1]
School of Medicine, Manchester University, UK.

Introduction:

A wide range of myoelectric prostheses is available which claim to provide high levels of functional and cosmetic restoration. However, for unilateral, trans-radial amputees, the group on which this project focused, there is evidence that this additional functionality may not be widely exploited in everyday life. This is believed to contribute to the observed high prevalence of overuse injuries in the non-amputated arm (Black *et al.* 2005).

Current approaches to prosthesis functional evaluation involve either amputee self-report, or lab-based observations of functional performance. Neither approach provides directly observed data on upper limb function in a free living environment. The work presented here describes a new approach to prosthesis evaluation that addresses this limitation, namely upper limb activity monitoring.

Methods:

The study explored the feasibility of monitoring the nature and duration of upper limb activities performed with a prosthesis, using arm-located accelerometers combined with instrumentation to measure prosthesis hand opening/closing. It was proposed that by monitoring prosthesis hand opening and closing, it may be possible to identify periods corresponding to object acquisition – release (the so-called "manipulation phase"). By using such information to segment the acceleration signals, the classification problem (determining which activity is being performed from the measured acceleration signals) may become tractable.

The proposed instrumentation set was simulated, using 'virtual sensors', derived from reflective marker data. (10 Vicon Cameras, Vicon 612® Vicon Motion Systems, Los Angeles, USA.)

Marker data were used to simulate 3D accelerometers on the prosthetic forearm, amputated side upper arm and intact side forearm, together with a measure of hand aperture. A number of bimanual functional tasks were selected to be performed from a sitting and/or standing position. Before completing each of the tasks, the participants walked along a 2-metre walkway. Arm movement during walking and transition (walking to standing/sitting) were both considered non-functional tasks. These tasks were included as accelerometer data segmentation based on hand status may not be 100% reliable. Hence, a practical implementation of our approach may need to distinguish not only between different functional tasks, but also between functional and non-functional tasks.

Two upper limb amputees participated in the study; one visited for a second (retest) session. Acceleration data during walking, transition and the manipulation phase of the functional tasks were identified and labelled off-line using bespoke software. Dimensionality reduction was used to characterise the accelerometer signals, and these feature vectors were fed into a customised Artificial Neural Network (ANN) for task classification.
The performance of the ANN was firstly assessed within and between-subjects as well as between-days. Furthermore, the effects on classification accuracy of reducing the virtual sensor set were explored.

Result:
The ANN was found to be highly accurate within-subject (100%- 99.4% depending on the number of 'virtual sensors' used). Between-subject accuracy was found to range between 81% and 91.9%. Between-day classification accuracy ranged between 84% and 98%.

Conclusion:
These findings indicated that our proposed approach shows promise. However, further work is required to optimise the classifier, and demonstrate its implementation with physical sensors and under less constrained conditions.

Reference: Black N, Biden EN and Rickards J. 2005. Using potential energy to measure work related activities for persons wearing upper limb prostheses. Robotica 23: 319-327.

Reflective Notes

Title: **Use of rapid prototyping technology in producing silicone partial hand prostheses**

Presenter: Tomaz Maver, Prosthetist

Contact: Institute for Rehabilitation
Linhartova 51
1001 Ljubljana
Republic of Slovenia

Tel: 00 386 41 446 094
E-mail: tomaz.maver@gmail.com

Other Authors: Helena Burger, MD, PhD, Institute for Rehabilitation, Republic of Slovenia
Luka Butolin, BSc. Mechanical Engineering – researcher, TECOS Slovenian Tool and Die Development Dentre, Celje, Slovenia
Joze Weingartner, BSc. Mechanical Engineering , RTCZ Rapid Prototyping and Rapid Tooling Center, Hrastnik, Slovenia
Andrej Žužek , Mechanical Technician, IB-Procadd d.o.o., Ljubljana, Slovenia

Objectives

Manufacturing of silicone partial hand prostheses, at the Institute for Rehabilitation, has based on the shape of similar PVC cosmetic gloves or on the model of a similar hand of a third person, hich has not been similar enough to a patient's healthy hand. An aesthetic silicone prosthesis is helpful for subjects whose work involves personal contacts and for whom aesthetics is important(1).Therefore, in collaboration with partners the Institute has developed high resolution CAD-CAM technology for manufacturing of prostheses, the shape of which is a mirror-copy of the patient's healthy hand.

Methods and subjects

The three laser and optical scanners were tested in the making of a digitalized 3D model of a hand and stump: freescanner CAPOD CAD-CAM system, Zscanner 700 and 3D optical scanner ATOS II 400.
The 3D models of the hands were shaped, corrected and adjusted by means of internal software ATOS 6.0.0.3.
In the making of the master-model and tool, three technologies for fast manufacturing of pre-models and tools were tested: DMLS (Direct Metal Laser Sintering), SLS(Select Laser Sintering) and 3D print technology.

Results

During the development phase, the highest quality of scanning was achieved by ATOS II 400 (German company GOM), with visible skin details.
The highest apparency of skin details in the tool was achieved by the DMLS technology (Direct Metal Laser Sintering). In the testing of the SLS (Select Laser Sintering) technology and the 3D print technology, the accuracy was 0.1mm. The SLS technology was selected for tool manufacturing due to its accessible cost. The apparency of skin prints achieved by the SLS was not essentially lower than that achieved by the DMLS technology.
During the development phase, CAD-CAM technology processes were defined to enable the production of silicone prostheses after partial hand amputation, which in their form mirror the patient's healthy hand.
By using CAD-CAM high resolution technology, the highest-quality prosthetic design can be achieved even when the prosthetist lacks artistic skills.

Conclusion

The final appeareance of the prosthesis depends greatly on its shape. Our experiences in using the CAD-CAM high resolution technology have shown that such technology enables computer-based manufacturing of the prostheses, which in their form mirror the healthy hand. Such technology has been already used in designing and making of partial facial prostheses – epitheses (2). This technology provides the patients with the highest-quality lifelike prosthetic design

References

Burger H, Maver T, Marincek C. Partial hand amputation and work. Disabil Rehabil. 2007 Sep 15;29(17):1317-21.

1. Sykes LM, Parrott AM, Owen CP, Snaddon DR. Applications of rapid prototyping technology in maxillofacial prosthetics. Int J Prosthodont. 2004 Jul-Aug;17(4):454-9.

Reflective Notes

Title: **High Definition Silicone Cosmesis and upper limb absence. A user's questionnaire**

Presenter: Rebecca Beltran, Occupational Therapist

Contact: Roehampton Rehabilitation Centre
Queen Mary's Hospital
Roehampton Lane
London, SW15 5PN

Tel: 0208 487 6139
Fax: 0208 487 6907
E-mail: rebecca_beltran@hotmail.com

Other Authors: Nick Hillsdon, Clinical Specialist Prosthetist, Roehampton Rehabilitation Centre, Queen Mary's Hospital, London

Introduction

High definition silicone has been used since the 1990s in the manufacturing of cosmetic prostheses for clients with upper limb absence. Its appeal lies in its unique enhanced natural finish. However, the manufacturing process is time consuming and the cost high.

There is very limited research available relating to psychological benefits of high definition silicone cosmesis or levels of satisfaction amongst users. Provision and availability of this product is variable around the UK. There are not set prescription criteria or guidelines to date.

Aim

This study seeks to find out levels of satisfaction amongst upper limb clients and their views on high definition silicone cosmesis (HDSC) at Roehampton Rehabilitation Centre, London.

Method
50 established upper limb clients currently wearing high definition silicone cosmesis, age 18 and over, with different levels of limb absence (amputation or congenital limb deficiency), were sent a postal questionnaire designed by the presenter and the centre's prosthetic upper limb team in December 2007.

Findings
60% (n=30) response rate
Gender: 20 female, 9 male
Most common level of limb absence = below elbow (n=17)
20 congenital and 10 amputee clients
High levels of satisfaction with aspects of cosmesis and its impact on psychological well being were recorded. Areas for improvement were highlighted.
Wearing patterns and use of this type of cosmetic prosthesis for other than purely cosmetic purposes were identified.

Discussion
Prescription did not favour particular groups, eg gender, age or level of limb absence. The team's clinical reasoning and current prescription has been confirmed to be appropriate and timely as significant high levels of satisfaction were recorded and its positive impact on psychological well being was highlighted clearly.

From an OT perspective, this study has shown that 50% of the respondents use their high definition silicone cosmesis/prosthesis for functional tasks, which has challenged the idea of a 'passive prosthesis'. This may increase wear and tear and the need for replacement sooner than the recommended time.

Recommendations
To re-audit client group and compare findings with other prosthetic centres.
To increase OT involvement in prescription.
To carry out separate projects for congenital clients, digit amputees and rates of rejection/replacement.

References:

Dudkiewicz I et al (2004) Evaluation of prosthetic usage in upper limb amputees. Disability and Rehabilitation 26 (1) 60-63
Gallagher P (2004) Introduction to th special issue on psychological perspectives on amputation and prosthetics. Disability and Rehabilitation 26 (14/15): 827-830

Reflective Notes

Title: **Light-weight full arm cosmetic prostheses for high level amputees**

Presenter: Nick Hillsdon, Clinical Specialist Prosthetist

Contact: Opcare Ltd
Roehampton Rehabilitation Centre
Queeen Mary's Hospital
Roehampton
London
SW15 5PN

Tel: 0208 487 6045
Fax: 0208 785 6339
E-mail: nick.hillsdon@wpct.nhs.uk

Other Author: John Keeler (Upper Limb Technician, Roehampton)

Patients with a high level of upper limb amputation have few options for a lightweight prosthesis. Forequarter amputees may use a lightweight shoulder cap but those wishing to wear a cosmetic limb have no lightweight off-the-shelf componentry. Previously forequarter patients wishing to wear an artificial arm would be fitted with a plastic shoulder cap with an endoskeletal arm, foam hand and cosmetic glove. This prescription often proved heavy, this is due to the fact that they rely almost totally on wide straps worn tightly around their chest to support the prostheses.

At Roehampton, in an attempt to dramatically reduce the weight of these arms, we have manufactured the upper arm section and socket from solid plasterzote with a simple hinge at elbow level to a hard p.v.c. glove. To date we have fitted three forequarter amputees, a shoulder disarticulation and a trans humeral amputee. The total weight of an average endoskeletal cosmetic arm is 1400gms and the total weight of the lightweight prosthesis is 360gms.

This design has proved both very lightweight and comfortable for the wearer, allowing patients who previously rejected the endoskeletal prosthesis can now wear this lightweight alternative prosthesis.

All the forearm sections on these lightweight arms are Centri hard PVC gloves which are supported by a simple perlon elbow joint with a stop in the plasterzote section.
All 5 patients so far fitted are female; their prostheses are supported by 2 straps to the bra. They all, without exception, now wear the lightweight prosthesis in preference to their standard limb.

I will demonstrate the prosthetic fitting and manufacturing of these lightweight prostheses. I will also show that plasterzote sockets are not only suitable for patients with very high levels of amputation but also for patients unable to wear standard trans humeral limbs because of lack of tolerance to weight.

Reflective Notes

EXHIBITION

Monday 19 - Tuesday 20 May 2009

TIPS would be incomplete without the collaboration of commercial organisations involved in upper limb prosthetics and rehabilitation. We acknowledge with thanks the support of our exhibitors, as well as the sponsorship of Otto Bock Healthcare plc and Touch Bionics.

Ottobock Healthcare PLC
32 Parsonage Road
Englefield Green
Egham
Surrey
TW20 0LD

Contact: Gill Day
Tel: 01784 744915
E-mail: gill.day@ottobock.com

Touch Bionics
Unit 3, Ashwood Court
Oakbank Industrial Estate
Livingston
West Lothian
EH48 2UG

Contact: Gaurav Mishra
Tel: 01506 438556
E-mail:
gaurav.mishra@touchbionics.com

Centri AB
c/o Denovo Healthcare Ltd
7 Mendip Business Park
Mendip Road
Rooksbridge
BS26 2UG

Contact: Ross Gibson
Tel: 01934 808416
E-mail: rgibson@denovohealthcare.com

Fillauer Companies Inc
c/o Denovo Healthcare Ltd
7 Mendip Business Park
Mendip Road
Rooksbridge
BS26 2UG

Contact: Ross Gibson
Tel: 01934 808416
E-mail: rgibson@denovohealthcare.com

ITAP
Stanmore Implants
210 Centennial Avenue
Elstree
WD6 3SJ

Contact: Bruce Steer
Tel: 0208 238 6500
E-mail: itap@stanmoreimplants.com

Motion Control Inc
115 N Wright Brothers Drive
Salt Lake City
Utah 84116
USA

Contact: Harold Sears
Tel: ++ 001 801 326 3434
E-mail: harold@utaharm.com

Ortho Europe Ltd
Mill Lane
Alton
Hants
GU34 2PX

Contact: Keith Bell
Tel: 01420 83294
E-mail: keith.bell@ortho-europe.co.uk

Polymer Systems Technology Limited
Unit 2, Network 4
Cressex Business Park
Lincoln Road
High Wycombe
HP12 3RF

Contact: Derek Williams-Wynn
Tel: 01494 446610
E-mail: dww@silicone-polymers.co.uk

REACH
PO Box 54
Helston
TR13 8WD

Contact: Sue Stokes
Tel: 0845 1306225
E-mail: sue@reach.org.uk

Realistic Prosthetics Ltd
19 Platts Eyot
Lower Sunbury Road
Hampton
Middlesex
TW12 2HF

Contact: Roger Parr
Tel: 020 8783 0099
E-mail: roger@realisticprosthetics.com

RSL Steeper Ltd
Unit 70, Kingsmill Business Park
Chapel Mill Road
Kingston
Surrey
KT1 3GZ

Contact: Bruce Rattray
Tel: 07721 399579
E-mail: bruce.rattray@rehab.co.uk

The National Centre for Prosthetics and Orthotics
University of Strathclyde
Curran Building
131 St James Road
Glasgow
G4 0LS

Contact: Rhona Murison
Tel: 0141 548 4716
E-mail: rhona.murison@strath.ac.uk