# Striding Forward

Report 2: The first three years of the Gait CCRE

March 2008











### **Our Goals**

#### Through clinical research, we aim to:

**FIND** new ways to improve the mobility of Australians with cerebral palsy, Parkinson's disease, osteoarthritis, stroke and sporting injuries.

GENERATE knowledge about the measurement, pathophysiology and rehabilitation of walking.

UNCOVER the causes of gait disorders and find new ways to measure them in a clinical setting.

ESTABLISH an improved evidence base for gait analysis and multi-disciplinary treatment of gait disorders.

**TRANSLATE** our new knowledge to improve walking in children, adults and older people.

**TRAIN** clinicians in medicine, surgery and allied health in best clinical and research practices for clinical gait analysis and gait rehabilitation.

**PROVIDE** excellent research training for post-graduate researchers in medicine, surgery, allied health and biomechanics.

FOSTER collaboration with top international research, clinical and industry partners.

SHARE resources and bring experts together in a coordinated, priority-driven research plan.

**DISSEMINATE** our new knowledge to patients, health care organisations, professional organisations, industry, the scientific community and the general public.

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### **Director's Report**

#### Richard Baker PhD CEng, CSci, Director, Gait CCRE

Stepping Out reported on our success in setting up the Gait CCRE over the first 18 months of funding. Striding Forward now reports on our continued success in running an internationally competitive research programme. We have received well over \$4 million in funding over and above our original grant. This included prestigious NHMRC and ARC projects as well as a large grant from the Michael J Fox Foundation in America. 117 papers have been published in peer-reviewed journals. Our team have presented over 20 keynote and over 100 other presentations at national or international conferences. The appendix contains the detail of all these achievements.

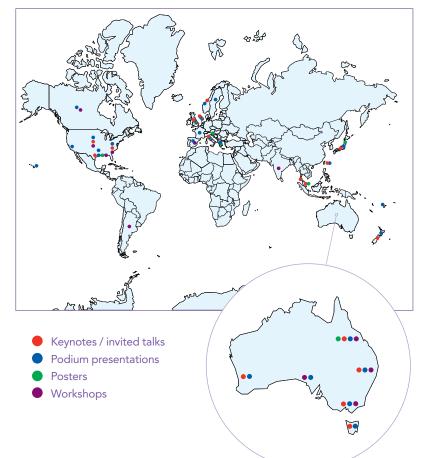
We have had particular successes in our clinical research training programme. Six students have completed PhDs and a further 19 are currently enrolled. Most of these have started with CCRE funding but have since been successful in obtaining competitive awards from the research councils or universities. We also have a growing team of 14 post-doctoral researchers who have won funding from a variety of sources to conduct their studies in the environment that the CCRE has created. Our regular Gait CCRE seminars have now had an aggregate attendance of over 900 and a two day course, Research Methods for Clinical Gait Analysis, attracted 45 delegates from across Australia and New Zealand.

Translating our findings into clinical practice is also a key priority. One of our strengths is having so many of our team sharing clinical and research appointments. The results of their research pass immediately into their own clinical practice. Team members have also been involved in over 25 workshops or instructional courses to pass their expertise onto practising clinicians. Our clinical research training fellowships have so far allowed 12 clinicians with little or no research experience to spend time collaborating on projects with experienced researchers. It has been a pleasure to work with a Board of Management committed to fostering a climate of high quality clinical research across diverse institutions and involving staff from a wide variety of professional backgrounds. We have managed funds well and will be able to continue to support research at the current level for the next two years. We have some reserves available that will focus on ensuring the optimal translation of our findings into routine clinical practice across Australia and throughout the world. It is only through doing so that we will achieve our ultimate aim of improving the mobility of Australians (and others) who have difficulty walking.

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Richard Baker PhD CEng CSci Director, Gait CCRE

International presentations from Gait CCRE team members





## **Research**: Improving Measurement Techniques

Chief investigators: A/Prof Richard Baker (MCRI/RCH), A/Prof Rory Wolfe (Monash University) Collaborators: lain Charlton (Vicon, UK)

Making better measurements: The Gait CCRE is now the leading international centre working to improve the quality of gait analysis measurements. Developments here are likely to form the basis for the next generation of gait analysis technology.

#### **Collaboration with VICON**

Vicon are based in Oxford, England and are the leading suppliers of gait analysis hardware and software internationally. They have chosen the Gait CCRE as their sole collaborators in developing a new generation of gait analysis software. Our aim is to use sophisticated kinematic modelling techniques to make measurements much less dependent on the skill of the person placing markers. This should make the measurements made in many centres world wide much more accurate than they are today.

#### Gaitabase

#### Removing the wobble

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The kinematic modelling work has been so successful that it has moved the goal posts. By removing human error, the biggest limitation on accuracy now comes from the way the skin and muscles move underneath the markers as a person walks. French post-doctoral fellow Dr Morgan Sangeux has recently joined the team to try and solve this problem working with PhD student Alana Peters.

#### Using the web

One of the problems with the Gait CCRE having a number of local partners is that we have had to find ways to share data. Dr Oren Tirosh has led the development of Gaitabase, a database for gait analysis which is accessible over the web. Although developed for internal use, Gaitabase has generated considerable interest internationally and we now have over 20 centres from 4 continents using the system. It allows data to be searched very easily and includes several analytical tools which are not available anywhere else.

#### Assuring data quality

With conventional methods of gait analysis so dependent on where individual clinicians place markers it is important to have tools that can guarantee how well those clinicians perform. Physiotherapist Dr Jenny McGinley and biostatistician Pam Simpson have been collaborating to do just this. Their technique has now been incorporated within Gaitabase and is freely available to anyone. The Technical Standards Group of the Gait and Clinical Movement Society now recommend its use.

STRIDING FORWARD: THREE YEARS OF THE GAIT CCRE

Post-doctoral Research Fellows:	Project:
Jenny McGinley (MCRI)	Measurement variability and data quality
Oren Tirosh (MCRI)	Gaitabase
Morgan Sangeux (RCH)	Compensating for soft tissue artefact
Fiona Dobson (MCRI)	Gait classifications and profiles
Post-graduate Students:	
Alana Peters (The University of Melbourne)	Avoiding soft tissue artefact
Mohammadreza Mohebbi (Monash University)	Statistical techniques for gait analysis data
Research Assistants:	
Pam Simpson (Monash University)	Gait reliability profiles
Sargei Shadou (MCRI)	Gaitabase
Clinical Research Training Fellows:	
Andy Franklyn-Miller	Comparing running and walking gait assessment
Rachel Ward	The kinematics of the knee joint

### Research: Gait Analysis in Paediatric Orthopaedics

Chief investigators: Prof H Kerr Graham (MCRI/RCH)

**Collaborators:** Prof Karen Dodd, Prof Nicholas Taylor (La Trobe), A/Prof Barry Rawicki, Christine Blackburn (Monash Medical Centre), John Rodgers (Allergan)

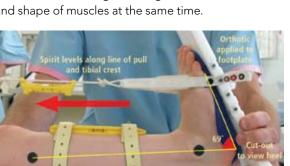
Helping children with cerebral palsy (CP): With support from the Gait CCRE the team at The Royal Children's Hospital now have the world's most comprehensive clinical research programme in this field.

#### World first trial

The randomised clinical trial (RCT) is the gold standard of clinical research. In the past it has just been considered too difficult to attempt such a trial of orthopaedic surgery for children with CP. Now the team at RCH has done just that with Pam Thomason as study co-ordinator. Results show exactly how effective surgery is and will allow families and surgeons to make more informed choices about what is best for their children.

#### **Botox injections**

Previous work by the CCRE Chief Investigators has found out the most effective dose for a single injection of Botulinum toxin. The National Health and Medical Research Council is now funding the Gait CCRE to find how often those injections should occur. Tandy Hastings-Ison is co-ordinating this project following 70 children over 2½ years. Collaborators in Texas, USA and from Griffith University on the Gold Coast will examine immunological responses and use ultrasound to investigate changes to the size and shape of muscles at the same time.



#### Keeping things simple

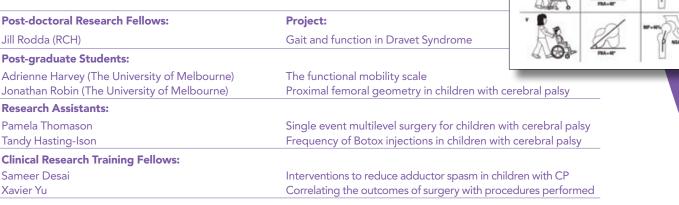
Not everyone has access to full gait analysis facilities particularly in the developing world. For the last 10 years RCH has been using standardised video footage for patients where a full 3-dimensional assessment is not possible. Physiotherapists Adrienne Harvey and Dr Jill Rodda have presented extremely successful workshops on this topic at the last two meetings of the American Academy of Cerebral Palsy and Developmental Medicine. The Gait CCRE will now be developing a package to allow other centres, particularly those in India and South-East Asia to establish such services.

#### **Training surgeons**

Dr Jonathan Robin will soon be the first surgeon to complete a Doctorate of Medicine through the Gait CCRE. His research has found a way of classifying hip problems in children with CP which makes it easier to identify which children are likely to benefit from which surgery.

Proximal femoral geometry in children with cerebral palsy and its effects on hip displacement.

Standardisation of the applied dorsiflexion moment used to better measure calf contracture in children with cerebral palsy.



3D gait analysis of a child with cerebral palsy



### Research: Motor Control in Adults and Children with Movement Disorders

Chief Investigator: Prof Robert lansek (Southern Health)

Biomechanist: Dr Anna Murphy (Southern Health)

**Collaborators:** Dr Nicole Rinehart, Dr Nellie Georgiou-Karistianis (Monash University), A/Prof Damien Jolley, Prof Don Campbell, Jennifer Watts, (Monash University)

Exploring the central control of gait: Understanding how the brain controls walking is a priority to improve the walking and balance of people with brain disorders.

#### The brain is like a computer

Whilst we now know quite a lot about the hardware used by the brain for walking, the software programs are still poorly understood. The Clinical Research Centre for Movement Disorders and Gait based at the Kingston Centre focuses on understanding how the brain software programs for walking become disturbed in diseases of the brain. This knowledge is used to develop appropriate interventions to assist people with walking disturbance.

#### Examining the brain software

Dr Frances Huxham & Mary Danoudis have examined the relationship between the step frequency and size in automatic and conscious control of gait. Frances & Prof David Reutens are looking at which brain structures are responsible for automatic and conscious control of gait by the use of brain imaging technology. Dr Anna Murphy & Dr Peter Enticott have developed a process to look at electrical activity of the brain and how the features of this activity and its location over the scalp changes to either the automatic or conscious control of gait.

#### **Detecting corrupt software**

Increased understanding of faulty software programs are being applied to specific neurological conditions that impact on the control of walking. Anna Murphy, Dianne Cameron & Dr Sanjay Rajdev have looked at the walking patterns that occur when walking comes to a stop in people with Parkinson's. Rachel Chee, Anna Murphy & Mary Danoudis have examined the footstep pattern in people with Parkinson's who have sudden freezing during walking to understand the software malfunction leading to the freeze. Walking problems in young children with Autism and Asperger's syndrome have also been described by Dr Nicole Rinehart, Dr Jenny McGinley, Anna Murphy & Dr Ashwini Nayate in conjunction with Prof John Bradshaw and Prof Bruce Tonge. Motor dysfunction in William's syndrome is currently being studied by Nicole Rinehart, Jenny McGinley and Darren Hocking in conjunction with John Bradshaw.

#### Clinical repair of corrupt software

Within our clinical service we have developed rehabilitation programs that are based on research outcomes. We continuously modify these programs according to current research findings. Programs have been implemented through the clinical service at Kingston Centre & Elsternwick Private Hospital utilising multi disciplinary teams across Melbourne and have contributed to the Centre of Excellence award from the National Parkinson Foundation in the US.

Post-doctoral Research Fellows:	Project:
Frances Huxham (Southern Health)	Turning in people with Parkinson's disease
Peter Enticott (Monash University)	EEG during gait in Parkinson's disease
Post-graduate Students:	
Mary Danoudis (La Trobe University)	Spatiotemporal gait characteristics of adults with Frontal Gait Apraxia
Ashwini Nayate (Monash University)	Motor functioning in autism and Asperger's disorder
Darren Hocking (Monash University)	Oculomotor, upper limb, & gait dysfunction in Williams syndrome
Rachel Chee (Monash University)	Dual causation of freezing of gait in Parkinson's disease:
Mary Karamitsios (Monash University)	A comparative study of gait in early psychosis and autism
Research Assistants:	
Dianne Cameron	Step changes in a planned stop in people with Parkinson's disease
Mary Danoudis	Evaluation of step to step variability in Frontal Gait Apraxia
Kate Ward	All projects
Susan Wilson & Melanie Toy-Laing	Motor functioning in autism and Asperger's disorder
Clinical Research Training Fellow:	
Sanjay Raghay	Step variability leading to stopping in Parkinson's disease



Researcher Mary Danoudis tests a person with Frontal Gait Apraxia in the Gait Laboratory.

### Research: Gait Analysis and Rehabilitation in Adults in Health and Disease

PhD Graduate Gavin Williams with supervisor and Gait CCRE Chief Investigator Prof Meg Morris at The University of Melbourne Graduation Ceremony.

#### Chief Investigator: Prof Meg Morris (The University of Melbourne)

Associate Investigator: Mr Tim Wrigley (The University of Melbourne)

**Collaborators:** Dr Sandra Brauer (University of Queensland), A/Prof Hylton Menz, Prof Nicholas Taylor (La Trobe University), Dr Clarissa Martin (The University of Melbourne), A/Prof Louise Ada, Dr Catherine Dean, (The University of Sydney), Prof Marjorie Woollacott (Canada), Dr Catherine Said (Austin Hospital)

Generating new knowledge on the outcomes of gait and mobility programs on the health and well-being for adults in health and disease: Carefully designed clinical research using good outcome tools tell us which types of therapy best improve gait and mobility in people with walking disorders. Effective therapy programs can then be quickly translated into clinical rehabilitation practice.

#### Helping people with Parkinson's disease stay on their feet

Many people with Parkinson's fall while walking. We are running the first large scale randomised clinical trial in the world to look at whether different types of outpatient physiotherapy programs can prevent falls and improve mobility in people with Parkinson's. This Michael J Fox Clinical Discovery Grant funded project will follow people for over a year and provide important information about how often they fall and the nature and consequences of those falls. The NHMRC has also provided funding to investigate whether a home-based rehabilitation program is effective in reducing falls in people with Parkinson's. An international team of researchers will also study how walking changes when people do another activity while walking.

#### Helping older people return home faster

Many older people have difficulty with walking and mobility and require rehabilitation while in hospital. A team supported by an Austin Hospital Medical Research Foundation grant and led by Dr Cathy Said is investigating whether increased physical activity in older people receiving hospital based rehabilitation allows them to return home sooner.

#### Facilitating life participation

Many people following brain injury and stroke experience restricted participation in many employment, social, leisure and sporting activities due to limited high level mobility. A team that is led by post-doctoral researcher Dr Gavin Williams and A/Prof Paul McCrory is currently looking at how effective a high level mobility program is in assisting people with brain injuries to achieve better participation and quality of life.

Post-doctoral Research Fellows:	Project.	CANCELL .
	Project:	
Gavin Williams (Epworth Rehabilitation)	High level mobility in people with head injuries	
Post-graduate Students:		PhD student, Brook Galn
Brook Galna (The University of Melbourne)	Obstacle negotiation in Parkinson's disease	demonstrates 3D gait
Pagamas Piriyaprasarth (The University of Melbourne)	Proprioceptive disturbances in stroke patients	analysis during stepping over an obstacle.
Siok Bee Tan (The University of Melbourne)	Quantification of mobility and quality of life in Parkinson's disease	
Sze Soh (The University of Melbourne)	Effects of physiotherapy on gait in Parkinson's disease	
Research Assistants:		
Joika Anand	Quantification of gait in older adult therapy outcomes	
Iliasipa Paumolevuka	Project officer for Michael J Fox Trial	
Libby Proud, Margaret Bruce	Testers, Michael J Fox Trial	
Clinical Research Training Fellows:		
Melanie Farlie Physiotherapist (Southern Health)	The effects of progressive strength training in older adults	
Helena Ng Geriatrician (Southern Health)	The effects of footwear on gait in stroke patients	
Una Goldsworthy	Accuracy of the AMP 331 monitor for measuring walking	
Pam Fok	Dual task interference during Parkinson gait.	
Sam Leitch	Orthotic management of Achilles tendinopathy	

### Research: Gait Analysis in Adults with Osteoarthritis

Chief investigator: A/Prof Julian Feller (La Trobe University) Associate Investigators: Dr Kate Webster (La Trobe University) Collaborator: A/Prof Hylton Menz (La Trobe University)

Understanding osteoarthritis: Osteoarthritis (OA) of the joints of the lower limb is a major cause of disability worldwide. Our research group is using gait analysis to improve our understanding of the causes of OA, how individuals function with OA, and the effects of interventions, both surgical and non-surgical.

#### Does knee reconstruction work?

Anterior cruciate ligament rupture is a common knee injury that is linked with the subsequent development of OA. Typically the ligament is reconstructed to restore function, but long term results suggest that this may not prevent the development of OA. Research leader Dr Kate Webster has co-ordinated a number of projects investigating the mechanics of the knee after reconstruction which have provided a possible explanation of why this is the case.

#### What's different about people with osteoarthritis?

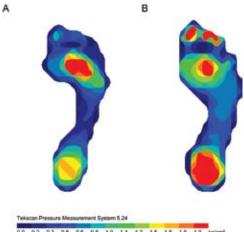
Knee cap (patella) pain is a very common problem. The same biomechanics that contribute to this problem may be associated with the development of OA of the knee. Christian Barton is currently looking at the effect of orthoses on the biomechanics of the knee and foot in this condition. Podiatrist and PhD student Gerard Zammit is also looking at biomechanics of the osteoarthritic foot. Post-doctoral Fellow Dr Pazit Levinger has been using mathematical models to identify pathological gait patterns in individuals with OA knee.

#### Are knee replacements as good as we think they are?

Kate Webster has also co-ordinated a number of studies looking at the function of individuals following surgery for knee OA. Physiotherapist

and PhD student Jodie McClelland has developed models to look at the function of patients who have had a knee replacement surgery. This work has shown ongoing biomechanical problems in patients that function very well. This is important knowledge for rehabilitation following this type of surgery. Kate Webster and physiotherapist Joanne Wittwer have also discovered that the confidence of patients after knee replacement surgery may not reflect their abilities.

An example of typical peak plantar pressure recordings from a control participant (A) and a participant with 1st MPJ Osteoarthritis (B)



10 11 13 15 14 18 19

Post-doctoral Research Fellows:	Project:	
Pazit Levinger (La Trobe University)	Foot pressure patterns and knee osteoarthritis	
Post-graduate Students:		
Jodie McClelland (La Trobe University)	Gait analysis after knee replacement surgery	
Gerard Zammit (La Trobe University)	Biomechanics of the osteoarthritic foot	
Christian Barton (La Trobe University)	The influence of orthoses for anterior knee pain	
Research Assistants:		
Joanne Wittwer (La Trobe University)	Knee biomechanics before and after tibial osteotomy	
Clinical Research Training Fellows:		
Bjorn Barenius	Reconstruction of the anterior cruciate ligament	
Katja Tecklenburg	Biomechanics of patellar stabilisation	



Three-dimensional gait analysis of a person as he jumps from a step recorded at the Musculoskeletal Research Centre at La Trobe University

# Research: Muscle Function in Walking

Chief investigator: Marcus Pandy (The University of Melbourne)

Making sense of muscles: We walk by contracting and relaxing our muscles. We are beginning to understand the role of specific muscles in normal walking and are now extending this work to different patient groups.

#### Doing the maths

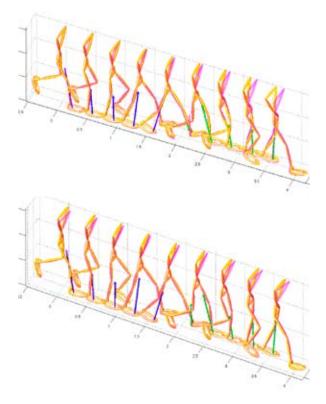
Working out how individual muscle actions contribute to the overall movement of the body requires advanced computational biomechanics. Gait CCRE post-doctoral researcher Dr Hyung Joo Kim has spent the last three years pioneering techniques to do this. This forms the basis of work being undertaken by an expanding team at The University of Melbourne.

#### Walking and running

If we want to get somewhere quickly we first walk faster and then start running. PhD student Mirjana Jancic is investigating how we change the way our muscles work in order to do this using Hyung Joo's models. Whilst conducting another study, postdoctoral researcher Dr Anthony Schache recorded an AFL footballer pulling a hamstring muscle. This is the only known recording of such an injury occurring. Anthony is now also using Hyung Joo's models to try and work out exactly why the muscle tore in the hope that this can help prevent such injuries in the future.

#### Out of the laboratory and into the hospital

A strength of the Gait CCRE is in drawing together scientists and clinicians. Based on the Gait CCRE collaboration between The University of Melbourne and The Royal Children's Hospital, the Australian Research Council has awarded a prestigious Discovery Grant to allow the application of these computational biomechanical techniques to investigate walking in children with cerebral palsy. This will give orthopaedic surgeons a better understanding of exactly what surgery will be of most benefit to the individual child.



Comparison of a subject walking and motion-tracking results using 1) Neuromusculoskeletal Tracking (A), and 2) Computed Muscle Control (B) methods. Both tracking methods utilise linearised feedback control to reproduce the captured subject walking motion based on forward dynamics. The yellow postures are the snapshots from tracking and the pink figures are those from experiments. The ground reaction forces are represented as blue and green arrows.

#### **Post-doctoral Research Fellows:**

Hyung Joo Kim (The University of Melbourne) Justin Ferandez (The University of Melbourne) Anthony Schache (The University of Melbourne) Kay Crossley (The University of Melbourne)

#### **Post-graduate Students:**

Lauren Quaranta (The University of Melbourne) Mirjana Jancic (The University of Melbourne) Massoud Akbarashahi (The University of Melbourne)

#### **Project:**

Muscle forces and models during human locomotion X-ray fluoroscopy and computational modelling Biomechanics of normal and pathological locomotion Osteoarthritis at the patellofemoral joint

Muscle function in walking over obstacles Changes in leg muscle function with walking speed Measures of kinematics using biplanar x-ray fluoroscopy



Quantification of skin motion artefact during different dynamic activities using x-ray fluoroscopy. Work at

The University of Melbourne,

Manufacturing Engineering.

Department of Mechanical and

### Education

#### Education is a high priority of the Gait CCRE.

Our primary educational focus is on our PhD students. Our PhD students have an excellent record of moving on from Gait CCRE support to competitive research council or university scholarships and we have a very high completion rate.

We also run a regular seminar program that has an aggregate attendance of over 900. Speakers are recognised locally, nationally and internationally. One highlight was the presentation given by BJ Fregly of the University of Florida on "Computational Modelling of Knee Mechanics". A two day instructional course "Research Methods for Clinical Gait Analysis" attracted 45 delegates from across Australia and New Zealand.  $\label{eq:simulation-Distribution of pressure on the tibial component of a total knee replacement.$ 



From Gait CCRE Seminar: Computational Biomechanics of the Knee Joint by BJ Fregly.

#### Student Profiles

#### Bridging the communication barriers

Clinical physiotherapist Adrienne Harvey recently submitted her doctoral thesis which looked at a new assessment tool, the Functional Mobility Scale (FMS). This new scale describes how children with cerebral palsy move in different environmental settings of the home, school and wider community depending on the need for assistive devices such as crutches or a wheelchair. It provides clinicians with an easy to use tool for monitoring and describing mobility over time or following surgery. "The most exciting part of this research is that the FMS is now starting to be used in countries where they don't have ready access to high tech equipment," Adrienne explains.

The FMS is now being used in many centres from countries such as the USA, Canada, New Zealand, India and Egypt. It has also been translated into different languages such as Dutch and Swedish. Pocket-sized cards describing the FMS levels have been printed for easy reference.

Adrienne presented her work at the AACPDM held in Boston in 2006 where she won the prestigious Best Scientific Poster Prize Award. She now anticipates moving into post-doctoral research abroad in Canada where she will continue to measure function in children and maintain links with the Gait CCRE.

#### Bringing practice and research together

Gerard Zammit, a recent podiatry honours graduate from La Trobe University, has combined his clinical career with research by working as a research assistant and now by pursuing a PhD. He says he enjoys the contrast between clinical and academic work and the challenge of problem solving. It was the opportunity to delve deeper into clinical questions that attracted him to pursue a post graduate degree.

Working at the Musculoskeletal Research Centre at La Trobe University, Gerard's area of interest

is osteoarthritis of the first metatarsophalangeal joint (big toe) known as hallux limitus/rigidus. This degenerative arthritic condition of the big toe is commonly characterised by pain, inflammation, restricted motion and disability. It is suggested that one in 40 adults over the age of 50 suffer from the condition.

Gerard is set to embark on conducting a randomised controlled trial to assess the effectiveness of a synovial fluid supplementation called "Hyaluronan Synvisc" in the treatment of hallux limitus under the supervision of A/Prof Hylton Menz and Dr Shannon Munteaunu at La Trobe University.

#### Tracking footsteps to solve the unknown

Clinical and research physiotherapist, Mary Danoudis has just completed a Masters of Physiotherapy at La Trobe University looking at the spatiotemporal gait characteristics of adults with Frontal Gait Apraxia (FGA). This condition can affect up to a fifth of the elderly population, however there are currently no agreed diagnostic criteria for the condition. Diagnosis is based on clinical features and the elimination of other neurological conditions.

Mary's work highlighted that people with FGA walked slower than controls, with smaller steps, a greater mean base width and greater step to step variability. The walking patterns of people with FGA were also characterised by freezing when walking, decreased foot clearance, decreased arm swing and flexed posture. This work was presented as a poster at the First Asian & Oceania Parkinson's Disease and Movement Disorders Congress held in Singapore in 2007.

Mary pursued a Masters to develop appropriate research skills to help her in her work as a clinical and research physiotherapist. "The masters program was excellent for learning the process of research" she says. "It helped me identify the gaps in knowledge, better formulate and test my questions and provided skills to put a research study together".



PhD student Adrienne Harvey



PhD student Gerard Zammit from the Musculoskeletal Research Centre at La Trobe University.



Clinical and research physiotherapist Mary Danoudis from Kingston Centre.

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### Translation

### Clinical research only benefits the Australian population if its results are translated into clinical practice.

An increasing role of the Gait CCRE is thus to ensure that we incorporate what we find into our own clinical practice and that we communicate our findings with other clinicians nationally and internationally. One important initiative here is publishing all Gait CCRE PhD theses in paperback form and mailing copies to key opinion leaders across the world.



Another important part of our translational program is the Clinical Research Training Fellowship Scheme (CRTFS). In this scheme practicing clinicians with little or no research experience are invited into the Gait CCRE to work alongside experienced researchers on specific projects. So far physiotherapists, geriatricians, podiatrists, orthopaedic surgeons, neurologists and biomedical engineers have all had a chance to benefit from this scheme.

#### Clinical Research Training Fellowships

#### If the shoe fits

Dr Helena Ng is a geriatric registrar who has worked within the Southern Health Care Network for the last 6 years and at Kingston Centre for the last 12 months. She embraced the opportunity to be part of the CRTFS under the mentorship of Dr Velandai Srikanth and Prof Barbara Workman of Monash Medical Centre and Kingston Centre and CCRE Investigators Prof Meg Morris and Dr Jenny McGinley.

With clinical interests including falls and balance, movement disorders and stroke, Helena has just completed a research project as part of her Geriatric training and the CRTFS. Following the observation that people following a stroke often have impaired gait and balance and tend to wear footwear that is comfortable rather than safe, this project looked at the effect of different footwear, including typical walking shoes, slippers and no shoes, on walking and balance in people following a stroke. Helena explains that there is very little data available about the best type of footwear following stroke.

Helen proposed that walking would be better in walking shoes and worse in slippers. She used the GAITRite walking system and the functional reach test as measurement tools to measure walking and balance. Both these measurement systems are portable and easy to use in the clinical setting. Helena anticipates finishing her registrar training in 2009 and plans a career as an Aged Care Consultant. She says her participation in the CRTFS has given her an invaluable opportunity to participate in clinical research.

#### Marching to the front line

Dr Andy Franklyn-Miller is a Clinical Sports Medicine Fellow based at the Centre for Health, Exercise and Sports Medicine at The University of Melbourne and is practicing at the Olympic Park Sports Medicine Centre. Andy comes to Australia from the UK to pursue further research endeavors and to work as the team doctor for the Melbourne Storm NRL team. Andy is also a serving officer, Surgeon Lieutenant Commander, with the Royal Navy (UK) and has completed research for a Doctorate of Medicine on lower limb injury prevention in military training using a pressure plate (Footscan<sup>®</sup>) system.

Andy's current interests are in physiology for elite sport and lower limb injury prevention. His research project associated with the CRTFS involves looking at the difference between walking and running gait using the Footscan<sup>®</sup> system. This work is being conducted in collaboration with A/Prof Richard Baker and A/Prof Paul McCrory, Head of Sports Medicine Research at CHESM.

Andy has been awarded additional funding for his training from the Royal Navy (UK) and through a Clinical Sports Medicine Scholarship. He anticipates returning to the UK at the end of this year and hopes that findings from this research will be influential to reducing military injury rates. "By conducting this research we hope to halve the lower limb injury rates that occur in military personnel" explains Andy.



Dr Helena Ng, Geriatric Registrar and recipient of a Clinical Research Training Fellowship.



Dr Andy Franklyn-Miller

### **Appendices to Report**

#### Keynote addresses and other invited presentations

#### H Kerr Graham

- First POSNA ASEAN Paediatric Orthopaedic Course. Kuala Lumpur, Malaysia, 2005.
- Princess Margaret Hospital. Perth. 2005.
- POSNA Annual Meeting. San Diego, USA. 2006.
- POSNA and AAOS 4th Annual International Pediatric Orthopaedic Symposium. Florida, USA, 2007.
- POSNA-ASEAN Paediatric Orthopaedic Course. Singapore, 2007.
- 20th Annual Stuart Reiner Lecture: American Association of Neuromuscular & Electrodiagnostic Medicine. Phoenix, USA 2007.
- Rady Children's Hospital. San Diego, USA, 2007.
- RACP Annual General Scientific Meeting. Melbourne, 2007.

#### **Robert lansek**

- Physicians Multidisciplinary Symposium. Qld 2006.
- Memory and Movement Specialist Forum. Victoria, 2006.
- Aged Care Conference, Victoria, 2006.
- Fitzpatrick House, Specialist Surgeons. Victoria. 2006.
- Recently Diagnosed Seminar, Parkinson Victoria. 2006.
- Monash Medical Centre. Victoria. 2006.
- Swan Hill Hospital. Victoria. 2006.
- 10th International Congress of Parkinson's Disease and Movement Disorders. Kyoto, Japan. 2006.
- Satellite Symposium Kyoto, Japan, 2006.
- Parkinson's Victoria. 2007.
- Society of Pharmacists of Australia. Victoria. 2007.

#### **Richard Baker**

- Societa' Italiana di Analisi del Movimento in Clinica. Piza, Italy. 2005.
- Biomechanics of the Lower Limb in Health Disease and Rehabilitation. Salford, UK. 2005.
- Australian Member Society of ISPO. Sydney. 2005.
- International Society of Biomechanics Cleveland, Ohio, USA. 2005.
- First Joint Meeting of the ESMAC and GCMAS Amsterdam, The Netherlands. 2006.
- 6th Meeting of the Australia and New Zealand Society of Biomechanics. Auckland. 2006.
- XXI Congress of the International Society of Biomechanics. Taipei, Taiwan. 2007.
- 22nd Australasian Podiatry Conference. Hobart, 2007.

#### **Meg Morris**

- American Physical Therapy Association III Step Conference. Utah, USA. 2005.
- RESCUE Conference. Newcastle, UK. 2005European Parkinson's Disease Conference.
- Amsterdam, The Netherlands. 2005.
- International Parkinson's Disease Meeting. Washington, USA. 2006.
- Parkinson's Disease Forum. Perth. 2006.
- Parkinson Disease Association Australia Victoria. 2006.
- AGM Parkinson Disease Association Australia. NSW. 2006.

#### Marcus Pandy

- Alfred Deakin Innovation Lecture. Melbourne. 2005.
- 35th Annual Frontiers in Education. Indianopolis, USA. 2005.
- Dean's Lecture. The University of Melbourne. 2005.

#### Julian Feller

- Ullevaal University Hospital. Oslo, Norway. 2005.
- Australian Orthopaedic Association. Sydney. 2006.
- European Society of Sports Traumatology, Knee
- Surgery and Arthroscopy. Innsbruck, Austria. 2006.

#### Rory Wolfe

• Southampton Statistical Sciences Research Seminars. UK, 2006.

#### Workshops

Baker R. (2007). Moving ahead for children with cerebral palsy. CP Australia and Australasian Academy of Cerebral Palsy and Developmental Medicine Annual Workshop. Gold Coast, Australia. May.

Baker R, et al. (2007). Technical Symposium: Reliability of 3D kinematic gait measures. 12th Gait and Clinical Motion Analysis Society Meeting. Massachusetts, USA

Graham HK. (2007). Moving Forward. Current management of children and adolescents with cerebral palsy and neurological conditions. BC Children's Hospital, Vancouver, British Columbia, Canada. October.

Graham HK. (2007). The Physiology of Motor Development: Implications for Children with Motor Disabilities: The Novartis Foundation. London, UK.

Harvey A, Rodda J, Graham HK. (2007). Two-dimensional video gait analysis: applying the lessons from three dimensional gait analysis American Academy for Cerebral Palsy & Developmental Medicine 61st Annual Meeting. Vancouver, Canada. October

Baker R, et al. (2006). Symposium. Modelling concepts in motion analysis. Joint ESMAC GCMAS Meeting. Amsterdam, The Netherlands. September.

Graham HK, Dobson F, & Thomason P. (2006). Workshop. Hip displacement in cerebral palsy: Incidence, natural history, surveillance and management. Australasian Academy of Cerebral Palsy & Developmental Medicine Conference. Adelaide. March.

Graham HK, & Harvey A. (2006). The role of clinical gait analysis and functional assessment in the child with cerebral palsy: a two day course. Buenos Aires, Argentina. April.

Graham HK, Thomason P, & Howard J. (2006). Hip displacement in cerebral palsy: What we know, what we don't know and what we would like to know. Annual Meeting of the American Academy of Cerebral Palsy and Developmental Medicine. Boston, USA. September.

#### Harvey A, Graham HK, Baker R, & Wolfe R. (2006). Responsiveness to change of the Functional Mobility Scale after single event multilevel surgery in spastic diplegia. Australasian Academy of Cerebral Palsy & Developmental Medicine Conference. Adelaide, Australia. March.

Harvey A, Rodda JM, & Graham HK. (2006). Twodimensional video gait analysis: Applying the lessons from three dimensional gait analysis. Annual Meeting of the American Academy of Cerebral Palsy and Developmental Medicine. Boston. September.

Howard J, Soo B, Graham HK, & Boyd RN. (2006). Cerebral palsy in Victoria: motor types, topography, and gross motor function. Australasian Academy of Cerebral Palsy & Developmental Medicine Conference. Adelaide, Australia. March.

lansek R, & Kirkwood B. (2006). Movement normalization strategies in Parkinson's Disease: Which, when & why. First World Parkinson Congress. Washington, USA. Feb.

lansek R, & Kirkwood B. (2006). The role of interdisciplinary teams in management of Parkinson's in Australia. First World Parkinson Congress. Washington, USA. February.

Rodda J, Harvey A, & Graham HK. (2006) 2-D gait analysis. Australasian Academy of Cerebral Palsy and Developmental Medicine Conference. Boston USA. March.

Van Campenbout A, Chambers H, Graham HK, Molenaers G, & Desloovere K. (2006). After injections with Botulinum toxin A – What happens now? American Academy of Cerebral Palsy and Developmental Medicine. Boston, USA. September.

Williams G. Retraining walking and running following stroke. March 2006 Newcastle, April 2006 Melbourne, July 2006 Adelaide, August 2006 Brisbane.

Baker R. (2005) ESMAC European Gait Course. Barcelona, Spain. September.

Baker R. (2005). Gait analysis in prosthetics and Orthotics. Australian Member Society of the International Society of Prosthetics and Orthotics. Sydney, Australia. November.

Baker R, & Schache AG. (2005). Kinematic Modelling. International Society of Biomechanics. Cleveland, Ohio, USA. August.

Feller JA. (2005). Patellofemoral instability: new approaches to an old problem. 5th Biennial Conference of the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine. Hollywood FL, USA. April.

Graham HK. (2005). Asia Pacific Childhood Disability Update. Mumbai, India. December.

#### **Grants awarded**

#### 2008

Brauer, Morris, Woollacott. Effects of dual task performance during gait in Parkinson disease. NHMRC project grant. \$320,000 (3 yrs).

Davis, Reddihough, Waters, Boyd, Mackinnon, Graham. A quality of life questionnaire for adolescents with cerebral palsy for clinical and public health research and practice. The William Buckland Foundation. 577,056 (1 yr).

Morris, Menz, Taylor, Huxham, Martin. Effects of home based rehabilitation in Parkinson disease. NHMRC project grant. \$720,000 (3yrs).

Pandy, Baker, Graham, Merritt. Patientspecific Computational Tools for Diagnosing and Treating Gait Disorders in Children with Cerebral Palsy. ARC Discovery Project (Number DP0878705). \$350,000 (3 yrs).

Taylor, Graham, Dodd, Baker. Targeted strength training to improve functional walking capacity of adolescents and young adults with cerebral palsy. NHMRC Project Grant (Number 487321). \$265,050 (2 yrs).

#### 2007

Feller, Webster. Hamstring function following anterior cruciate ligament reconstruction using a hamstring tendon autograft: a biomechanical evaluation. Victorian Orthopaedic Research Trust. \$7,825 (1 yr).

Graham, Rawicki, Baker. An RCT to determine the optimum frequency of Botulinum Toxin injections to the calf in children with cerebral palsy NHMRC Project Grant (Number 454705). \$269,750 (1 yr).

Reddihough, Davis, Waters, Boyd, Mackinnon, Graham. A Quality of Life Questionnaire for adolescents with cerebral palsy for clinical and public health research and practice. Jack Brockhoff Foundation. \$73,472 (1 yr).

Rinehart, Tonge, Bradshaw, Iansek, McGinley. Motor Function in Autism and Asperger's disorder: Furthering current neurobehavioral and clinical definitions. NHMRC. \$341,875 (3yrs).

Williams, Morris, McCrory, Schache. Three dimensional motion analysis of high-level mobility following traumatic brain injury. Victorian Trauma Foundation. \$59,880 (1 yr).

#### 2006

Ada, Morris, Dean. Recovery of walking after stroke using treadmill training. NHMRC Project Grant (Number 02679). \$335,125 (3 yrs).

Baker, Rodda, Schache, Ditchfield. The validity of the next generation of clinical gait analysis measurement techniques. MCRI Musculoskeletal Theme Grant. \$11,200 (1 yr).

Culhane, Baker. A pilot study to evaluate three monitors for recording walking activity in children with cerebral palsy MCRI Musculoskeletal theme grant. \$10,078 (1 yr).

Huxham, lansek, Murphy, Cameron, Danoudis. A systematic investigation of gait: What can the spatiotemporal parameters of normal walking tell us about central control of gait and the impact of Parkinson's disease? John & Thirza Daley Charitable Trust. \$30,000 (2 yrs). lansek. The Comprehensive-Care Grant. National Parkinson Foundation. \$65,000 (1 yr).

lansek, Morris, Jolly, Campbell, Watts. Clinical and economic measures to evaluate disease status and progression in Parkinson disease. US National Parkinson Foundation. \$110,000 (3yrs).

Morris, lansek, Huxham, Menz, McGinley, Watts. Preventing Falls and improving mobility in Parkinson's disease. Michael J Fox Foundation Clinical Discovery Grant. \$820,000 (3 yrs).

#### 2005

Baker, Graham. Kinematics and kinetic modelling of gait data. Oxford Metrics \$160,000 (4yrs).

Baker, Graham, Schache, Ditchfield. Biomechanical modelling of hip muscle function during locomotion in children with cerebral palsy. MCRI Project Grant. \$58,749 (1 yr).

Boyd, Reddihough, Graham, Leventer. Vic CP Child – a longitudinal cohort study of CP children. MCRI Project Grant. \$50,000 (1 yr).

Brauer, Morris, Menz. Training dual tasking in Parkinson's disease. Brain Foundation Research Grant. \$20,050 (1 yr).

Feller, Webster. Gait Analysis for knee replacement surgery. Stryker Australia. \$30,000 (1yr).

Graham, Iansek, Morris, Pandy, Baker, Wolfe. Clinical gait analysis and gait rehabilitation. NHMRC CCRE Grant (Number 264597). \$2,000,000 (5yrs).

Hastings-Ison, Graham, Rawicki, Blackburn, Baker. Frequency of intramuscular Botulinum Toxin A injections and preservation of gastrocnemius length in ambulant children with cerebral palsy: a Randomised Controlled Trial. Allergan Plc. \$120,000 (2 yrs).

Williams. Three-dimensional motion analysis of high-level mobility following traumatic brain injury. Royal Automobile Club of Victoria. \$29,000 (1 yr).

Grant from Hugh Williamson Foundation to support Paediatric Orthopaedic Research within the CCRE. \$300,000.

#### **Book chapters**

Hutchinson R, Graham HK. Management of spasticity in children. In Barnes MP, Johnson GR eds. Upper Motor Neurone Syndrome and Spasticity. *Clinical Management and Neurophysiology*, Cambridge University Press. In press, accepted Jan. 2007.

Feller JA, Webster KE. Proprioception and anterior cruciate ligament reconstruction. In Prodromos CC ed. The Anterior Cruciate Ligament: Reconstruction and Basic Science. Philadelphia PA: Saunders Elsevier, 2008.

Morris ME, Huxham F, Menz HB, et al. Enhancing movement in people with Parkinson's disease and their care-givers. In Trail, Protas, Lai eds. Neurorehabilitation in Parkinson's Disease: An Evidence-Based Treatment Model. New York: Stack, 2008.

Bennell K, Hinman R, Wrigley T. Future Directions in Physical Therapy for Knee Osteoarthritis. In Sharma L, Berenbaum F, eds. Osteoarthritis. A Companion to Rheumatology. Philadelphia: Mosby Elsevier, 2007: 217-231. Graham HK. Neuromuscular Disorders: Cerebral Palsy. In Staheli LT, Song KM eds. *Pediatric Orthopaedic Secrets* 3rd ed: Mosby: Elsevier, 2007: 461-75.

Flett PJ, Graham HK. Cerebral palsy and Paediatric Neurorehabilitation In Selzer, Clarke, Cohen, et al. eds. Textbook of Neural Repair and Rehabilitation: Cambridge University Press, 2006: 636-56.

Goodwin CJ, Pandy MG. Muscle and joint loading at the shoulder. *Recent Research Developments in Biomechanics*, 2005: 43-54.

Morris ME. Impairments, activity limitations and participant restrictions in Parkinson's disease. In Refshauge KM, Ada L, Ellis E eds. Sciencebased rehabilitation: theories into practice. London: Butterworth Heinemann, 2005.

Morris ME, Baker R, Dobson F, et al. Clinical gait analysis in neurology. In Hausdorff JM, Alexander NB eds. Gait Disorders. Evaluation and Management. FL, USA: Taylor & Francis Group, 2005: 247-72.

Polgar S, Morris ME. Reconstructive neurosurgery: Progress towards a best practice treatment for people with Parkinson's disease. *Parkinson's Disease: New Research*, 2005: 41–68.

#### **Completed Dissertations**

Adrienne Harvey. 2008. The functional mobility scale. School of Physiotherapy. The University of Melbourne. Under examination.

Fiona Dobson. 2007. Classification of gait patterns in children with hemiplegic cerebral palsy. School of Physiotherapy. The University of Melbourne.

Jill Rodda. 2006. Severe crouch gait in spastic diplegia: the impact of single event multilevel surgery. School of Physiotherapy. The University of Melbourne.

Gavin Williams. 2006. The high-level mobility assessment tool for traumatic brain injury. School of Physiotherapy. La Trobe University.

Susan Morris. 2006. Effects of progressive strength training in traumatic brain injury. School of Physiotherapy. La Trobe University.

Natalyia Shkuratova. 2006. Age related changes in balance control during walking. School of Physiotherapy. La Trobe University.

Frances Huxham. 2005. Gait and turning disorders in Parkinson's disease. School of Physiotherapy. La Trobe University.

#### Papers published or accepted for publication

#### 2005

Altuntas AO, Balakumar J, Howells RJ, et al. Posterior divergent dislocation of the elbow in children and adolescents: a report of three cases and review of the literature. J Pediatr Orthop 2005; 25:317-21. Arnold AS, Anderson FC, Pandy MG, et al. Muscular contributions to hip and knee extension during the single limb stance phase of normal gait: a framework for investigating the causes of crouch qait. J Biomech 2005: 38:2181-9.

Bilney B, Morris ME, Churchyard A, et al. Evidence for a disorder of locomotor timing in Huntington's disease. *Mov Disord* 2005; 20:51-7.

Chin TY, Nattrass GR, Selber P, et al. Accuracy of intramuscular injection of botulinum toxin A in juvenile cerebral palsy: a comparison between manual needle placement and placement guided by electrical stimulation. J Pediatr Orthop 2005; 25:286-91.

Cooper RL, Taylor NF, Feller JA. A randomised controlled trial of proprioceptive and balance training after surgical reconstruction of the anterior cruciate ligament. *Res Sports Med* 2005; 13:217-30.

Cooper RL, Taylor NF, Feller JA. A systematic review of the effect of proprioceptive and balance exercises on people with an injured or reconstructed anterior cruciate ligament. *Res Sports Med* 2005; 13:163-78. Dobson F, Graham HK, Baker R, et al. Multilevel

orthopaedic surgery in group IV spastic hemiplegia. J Bone Joint Surg Br 2005; 87:548-55. Howard J, Soo B, Graham HK, et al. Cerebral palsy in

Victoria: motor types, topography and gross motor function. J Paediatr Child Health 2005; 41:479-83.

Lavcanska V, Taylor NF, Schache AG. Familiarization to treadmill running in young unimpaired adults. *Hum Mov Sci* 2005; 24:544-57.

Menz HB, Morris ME. Determinants of disabling foot pain in retirement village residents. *J Am Podiatr Med Assoc* 2005; 95:573-9.

Menz HB, Morris ME. Footwear characteristics and foot problems in older people. *Gerontology* 2005; 51:346-51.

Menz HB, Morris ME, Lord SR. Foot and ankle characteristics associated with impaired balance and functional ability in older people. J *Gerontol A Biol Sci Med Sci* 2005; 60:1546-52.

Morris M, lansek R, McGinley J, et al. Threedimensional gait biomechanics in Parkinson's disease: evidence for a centrally mediated amplitude regulation disorder. Mov Disord 2005; 20:40-50.

Muir D, Angliss RD, Nattrass GR, et al. Tibiotalocalcaneal arthrodesis for severe calcaneovalgus deformity in cerebral palsy. J Pediatr Orthop 2005; 25:651-6.

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Pizzari T, Taylor NF, McBurney H, et al. Adherence to rehabilitation after anterior cruciate ligament reconstructive surgery: Implications for outcome. *Journal of Sport Rehabilitation* 2005; 14:201-14.

Said CM, Goldie PA, Culham E, et al. Control of lead and trail limbs during obstacle crossing following stroke. *Phys Ther* 2005; 85:413-27.

Saunders SW, Schache A, Rath D, et al. Changes in three dimensional lumbo-pelvic kinematics and trunk muscle activity with speed and mode of locomotion. *Clin Biomech (Bristol, Avon)* 2005; 20:784-93.

Schache AG, Blanch PD, Rath DA, et al. Are anthropometric and kinematic parameters of the lumbo-pelvic-hip complex related to running injuries? *Res Sports Med* 2005; 13:127-47.

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Schoo AMM, Morris ME, Bui QM. The effects of mode of exercise instruction on compliance with a home exercise program in older adults with osteoarthritis. *Physiotherapy* 2005; 91:79-86.

Schoo AMM, Morris ME, Bui QM. Predictors of home exercise adherence in older people with osteoarthritis. *Physiotherapy Canada* 2005; 57:179-89. Shelburne KB, Torry MR, Pandy MG. Effect of muscle compensation on knee instability during ACL-

deficient gait. Med Sci Sports Exerc 2005; 37:642-8. Shelburne KB, Torry MR, Pandy MG. Muscle, ligament, and joint-contact forces at the knee during

walking. Med Sci Sports Exerc 2005; 37:1948-56. Stolwyk RJ, Triggs TJ, Charlton JL, et al. Impact of internal versus external cueing on driving performance in people with Parkinson's disease. Mov Disord 2005: 20:846-57.

Webster KE, Chiu JJ, Feller JA. Impact of measurement error in the analysis of bone tunnel enlargement after anterior cruciate ligament reconstruction. *Am J Sports Med* 2005; 33:1680-7.

Webster KE, Wittwer JE, Feller JA. Validity of the GAITRite<sup>®</sup> walkway system for the measurement of averaged and individual step parameters of gait. *Gait Posture* 2005; 22:317-21.

Webster KE, Wittwer JE, O'Brien J, et al. Gait patterns after anterior cruciate ligament reconstruction are related to graft type. *Am J Sports Med* 2005; 33:247-54.

Williams G, Robertson V, Greenwood K, et al. The high-level mobility assessment tool (HiMAT) for traumatic brain injury. Part 1: Item generation. *Brain Inj* 2005; 19:925-32.

Williams GP, Robertson V, Greenwood KM, et al. The high-level mobility assessment tool (HiMAT) for traumatic brain injury. Part 2: content validity and discriminability. *Brain Inj* 2005; 19:833-43.

Wright JG, Wang EEL, Owen JL, et al. Treatments for paediatric femoral fractures: a randomised trial. Lancet 2005; 365:1153-8.

#### 2006

Anderson FC, Liu MQ, Pandy MG, et al. Muscles that support the body also modulate forward progression during walking. *Journal* of *Biomechanics* 2006; 39:2623-30.

Baker R. Gait analysis methods in rehabilitation. *J Neuroeng Rehabil* 2006; 3:4.

Davis E, Waters E, Mackinnon A, et al. Paediatric quality of life instruments: a review of the impact of the conceptual framework on outcomes. *Dev Med Child Neurol* 2006; 48:311-8.

Dichiera A, Webster KE, Kuilboer L, et al. Kinematic patterns associated with accuracy of the drop punt kick in Australian Football. J Sci Med Sport 2006; 9:292-8.

Dobson F, Morris ME, Baker R, et al. Clinician agreement on gait pattern ratings in children with spastic hemiplegia. *Dev Med Child Neurol* 2006; 48:429-35.

Fernandez JW, Pandy MG. Integrating modelling and experiments to assess dynamic musculoskeletal function in humans. *Exp Physiol* 2006; 91:371-82.

Fosang A, Baker R. A method for comparing manual muscle strength measurements with joint moments during walking. *Gait Posture* 2006; 24:406-11.

Hopyan S, Tan JW, Graham HK, et al. Function and upright time following limb salvage, amputation, and rotationplasty for pediatric sarcoma of bone. J Pediatr Orthop 2006; 26:405-8.

Huxham F, Gong J, Baker R, et al. Defining spatial parameters for non-linear walking. *Gait Posture* 2006; 23:159-63.

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lansek R, Huxham F, McGinley J. The sequence effect and gait festination in Parkinson disease: contributors to freezing of gait? Mov Disord 2006; 21:1419-24.

Kruidhof J, Pandy MG. Effect of muscle wrapping on model estimates of neck muscle strength. *Comput Methods Biomech Biomed Engin* 2006; 9:343-52.

Liu MQ, Anderson FC, Pandy MG, et al. Muscles that support the body also modulate forward progression during walking. *J Biomech* 2006; 39:2623-30.

Ma FYP, Selber P, Nattrass GR, et al. Lengthening and transfer of hamstrings for a flexion deformity of the knee in children with bilateral cerebral palsy: technique and preliminary results. J Bone Joint Surg Br.2006; 88:248-54.

McGinley JL, Morris ME, Greenwood KM, et al. Accuracy of clinical observations of push-off during gait after stroke. Arch Phys Med Rehabil 2006; 87:779-85.

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Menz HB, Morris ME, Lord SR. Foot and ankle risk factors for falls in older people: a prospective study. *J Gerontol A Biol Sci Med Sci* 2006; 61:866-70.

Menz HB, Morris ME, Lord SR. Footwear characteristics and risk of indoor and outdoor falls in older people. *Gerontology* 2006; 52:174-80.

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Morris ME, Perry A, Bilney B, et al. Outcomes of physical therapy, speech pathology, and occupational therapy for people with motor neuron disease: a systematic review. *Neurorehabil Neural Repair* 2006; 20:424-34.

Pathak MS, Nguyen HT, Graham HK, et al. Management of spasticity in adults: practical application of botulinum toxin. *Eur J Neurol* 2006; 13 *Suppl* 1:42-50.

Piriyaprasarth P, Morris M, Winter A, et al. Physiotherapy assessment of knee proprioception following stroke. International Journal of Therapy & Rehabilitation 2006; 13:449-56.

Plummer P, Dunai J, Morris ME. Understanding the effects of moving visual stimuli on unilateral neglect following stroke. *Brain Cogn* 2006; 60:156-65.

Plummer P, Morris ME, Hurworth RE, et al. Characterisation of unilateral neglect by physiotherapists. *Disabil Rehabil* 2006; 28:571-7.

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Rinehart NJ, Tonge BJ, Bradshaw JL, et al. Gait function in high-functioning autism and Asperger's disorder: evidence for basalganglia and cerebellar involvement? Eur Child Adolesc Psychiatry 2006; 15:256-64.

Rinehart NJ, Tonge BJ, lansek R, et al. Gait function in newly diagnosed children with autism: Cerebellar and basal ganglia related motor disorder. Dev Med Child Neurol 2006; 48:819-24.

Rodda JM, Graham HK, Nattrass GR, et al. Correction of severe crouch gait in patients with spastic diplegia with use of multilevel orthopaedic surgery. J Bone Joint Surg Am 2006; 88:2653-64.

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Teichtahl AJ, Jackson BD, Morris ME, et al. Sagittal plane movement at the tibiofemoral joint influences patellofemoral joint structure in healthy adult women. Osteoarthritis Cartilage 2006; 14:331-6.

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Webster KE, Merory JR, Wittwer JE. Gait variability in community dwelling adults with Alzheimer disease. Alzheimer Dis Assoc Disord 2006: 20:37-40.

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Callisaya ML, Au BT, Blizzard L, et al. Subject -matter considerations in assessing the fit of a linear regression model. *Australasian Epidemiologist* 2007; 14:35-37.

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Feller JA, Amis AA, Andrish JT, et al. Surgical biomechanics of the patellofemoral joint. *Arthroscopy* 2007; 23:542-53. Gfoehler M, Redl C, Pandy MG. Sensitivity of muscle force estimates to variations in muscle-tendon properties. *Human Movement Science* 2007; 26:306-19.

Gibson N, Graham HK, Love S. Botulinum toxin in the management of focal muscle over activity in children with cerebral palsy. Disability & Rehabilitation 2007; 29:1813-22.

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Said CM, Goldie PA, Patla AE, et al. Balance during obstacle crossing following stroke. *Gait Posture* 2007; 25:229-35.

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Waters E, Davis E, Mackinnon A, et al. Psychometric properties of the quality of life questionnaire for children with CP. Dev Med Child Neurol 2007; 49:49-55.

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#### In press

Callisaya ML, Blizzard L, Schmidt MD, et al. Sex modifies the relationship between age and gait - a population-based study of older adults. Journal of Gerontology Series A: *Biological Sciences and Medical Sciences*. In press.

Hinman RS, Payne C, Metcalf BR, et al. Lateral wedges in knee osteoarthritis: what are their immediate clinical and biomechanical effects and can these predict 3-month clinical outcome? Arthritis Care & Research. In press

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Lewis A, Morris ME. A systematic review of the effects of physiotherapy exercises for low back pain. *Physiotherapy Reviews*. In press.

Lim B-W, Hinman RS, Wrigley TV, et al. Does knee malalignment mediate the effects of quadriceps strengthening on knee adduction moment, pain and function in medial knee osteoarthritis? A randomized controlled trial. Arthritis Care & Research. In press.

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Webster KE, Feller JA, Lamros C. Development and preliminary validation of a scale to measure the psychological impact of returning to sport following anterior cruciate ligament reconstruction surgery. *Physical Therapy in Sport*. In press.

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