The Winston Churchill Memorial Trust of Australia

Report by Karen Roberts

2008 Churchill Fellow

The Jack Brockhoff Foundation Churchill Fellowship to study current advances in rehabilitation services for upper limb amputees

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Signed: Karen Roberts Dated: 05.02.2009
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1. INTRODUCTION

This fellowship enabled me to travel to the USA, Scotland and Sweden to study current advances in rehabilitation services for people with upper limb amputations. Over the past few years there have been a number of advances in surgical techniques, new prosthetic components have been developed and greater acknowledgement has been made of the importance of therapy in maximising overall outcomes following prosthetic provision.

Given that significant funding is currently being provided for the development of technology for people with amputations, particularly in the USA, we should expect further developments in the years to come.

Therefore, this report provides a summary of my observation and learning from visits to specific centres and educational opportunities at this point in time within the scope of this Churchill Fellowship.

1.1 Acknowledgements:
I am extremely grateful to the Winston Churchill Memorial Trust of Australia and the Jack Brockhoff foundation for providing me with this opportunity to extend my knowledge and understanding in this important area of rehabilitation and occupational therapy practice. It is an honour to be awarded this fellowship and an even greater privilege to be able to pursue my passion to provide rehabilitation services to upper limb amputees in line with best international practice.

I would like to recognise the support that was provided my workplace, Caulfield Hospital, particularly the encouragement of Ms. Jane Lawrence (Manager of Occupational Therapy Services) and members of the Occupational Therapy Department. I would also like to give specific thanks to Dr. Andrew Nunn and Mr. David Wilson-Brown, my respected colleagues, who have been willing to share their knowledge with me and have been open to hearing a different perspective, always with the best interests of the patients at heart.

I would like to give great thanks to the colleagues in the organisations that I visited during this fellowship. I am grateful for their willingness to share their time, knowledge and expertise so generously. In particular I would like to thank Shawn Swanson for her assistance in identifying specific contact people in various centres and for her ongoing friendship.

I would also like to acknowledge the patients with upper limb amputations who I have worked with over the past decade. You have been willing to share your stories, to collaborate in partnership and to teach me of your experiences of living with an upper limb amputation. For your openness and willingness to help me understand, I am thankful.

Finally I would like to thank my family, particularly my husband. You encourage me, sustain me and remind me to “slow down” and appreciate my achievements.
2. EXECUTIVE SUMMARY

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2.2 Fellowship objective:
The aim of this fellowship was to study current advances in rehabilitation services for people with upper limb amputations.

2.3 Highlights
- Visiting the purpose built amputee care centres at Brooke Army Medical Center and Walter Reed Army Medical Center, and hearing the experiences of the returned service people and the therapists that work with them. Particular thanks to Major Jay Clasing and Capt. Sarah Mitsch.
- Participating in problem-solving discussions about specific patients with Chris Lake, Rob Dodson and Kristin Gulick at Advanced Arm Dynamics.
- Learning from people with multiple limb amputations and watching them complete particular activities at the Skills for Life II conference in Denver, Colorado. Also reflecting on the importance of support networks for these people.
- Meeting with Eric Westover from UpperEx and hearing his vision to increase support and access to resources for people with upper limb amputations.
- Discussing the contribution of occupational therapists to amputee research with Kathy Stubblefield, Dr. Liselotte Hermannson and Helen Lindner.
- Discussing the interface between technology and occupational performance with the engineers and prosthetists at Touch Bionics.
- Spending a week with the team at the Sahlgrenska Universitetssjukhuset and observing their work with osseointegration first hand.

2.4 Conclusion:
The number of people in Australia sustaining upper limb amputations each year is small but the effects of such a loss are large, often including significant restrictions in ability to perform daily living tasks, altered body image, changed social relationships and reduced ability to work. This fellowship provided opportunity to meet with international colleagues in a variety of centres and reinforced that much of our practice in Australia is following similar principles to those overseas. However, a number of Australian upper limb amputees are restricted in their prosthetic options by a lack of access to funding which may, at times, reduce their ability to reach their full potential. It may also be beneficial for the Australian health care system to identify specific centres of excellence in upper limb amputee management which can act as a resource for up to date information and possibly as a specialised assessment service utilising a team model that emphasises best international practice.

The information gleaned will be disseminated through formal teaching opportunities, sharing this report with Australian and international colleagues and discussing observations with upper limb amputees themselves.
3. FELLOWSHIP PROGRAMME - 2008

30th September – 2nd October: San Antonio, Texas, USA
• Brooke Army Medical Center, Fort Sam Houston – Center for the Intrepid

6th – 8th October: Dallas, Texas, USA
• Upper Extremity specialists
• Advanced Arm Dynamics

9th – 12th October: Denver, Colorado, USA
• Conference: Skills for Life II
• Meeting with Eric Westover, UpperEx National Outreach Coalition

14th – 15th October: Minneapolis, Minnesota, USA
• Otto Bock – Course: DynamicArm

20th – 23rd October: Chicago, Illinois, USA
• Rehabilitation Institute of Chicago / Northwestern University, Neural Engineering Center for Artificial Limbs

4th – 6th November: Washington D.C., USA
• Walter Reed Army Medical Center

11th-14th November: Edinburgh, Scotland, UK
• Touch Bionics
• Astley Ainslie Hospital

18th – 28th November: Sweden
• Universitetssjukhuset Örebro (University Hospital, Örebro)
• RödaKorset Sjukhus (Red Cross Hospital Amputee Center, Stockholm)
• Sahlgrenska Universitetssjukhuset (Sahlgrenska University Hospital, Gothenburg)
4. WHO ARE THESE PEOPLE WHO HAVE UPPER LIMB AMPUTATIONS?

Within the Australian community, there are a small number of people each year who experience upper limb loss. The majority of Australians who have upper limb amputations have sustained them as a result of work-related trauma or road traffic accidents. To a lesser extent, other individuals experience limb loss through congenital abnormality, infection, tumour or vascular disease where the cause may also impact upon adjustment and outcome.

In contrast, internationally there are a number of individuals who are experiencing traumatic amputations as a result of current armed conflict – particularly those service people who are engaged in conflict in Iraq & Afghanistan. Many of these individuals are experiencing poly-trauma as a result of improved explosive devices (IED’s) but are also surviving the trauma as a consequence of improved body armour and access to Rapid Air Medivac facilities which enables the serviceperson to receive life saving medical care within a short period of time.

Historically, armed conflict has provided the momentum for enhanced surgical techniques, improved prosthetic design and excellence in therapy services. Interestingly, the hospital where I am currently employed began its existence as the No. 11 Army General Hospital at Caulfield, Melbourne. Through the past century this momentum has been accompanied by a dedicated allocation of funding for improvement in physical facilities as well as in the areas of research and development. These current world events and their associated impact upon amputee service provision and prosthetic development, particularly in the USA, provided some focus for part of this Churchill Fellowship.

As an example of their experiences, this is my record of one conversation I had with a young man at a military amputee care centre:

One of the soldiers spoke to me about his injury this morning and I want to remember it... He said that he was in the passenger seat of an army vehicle in Iraq and he was holding a radio handset up to his right ear. The driver always sped up the vehicle when they went under an overpass. On this occasion, as they went under one of the overpasses four explosives shot off toward the vehicle. Two missed the vehicle completely. One went through the vehicle where his legs were, which meant that he ended up with two transfemoral (above-knee) amputations. The other hit his hand which was holding the radio. As he told it, it is because of the radio and his helmet that his face, sight and hearing were saved. His hand and wrist were badly damaged and he lost all of his extensor tendons on his right hand. But his face was okay.

It must be remembered that there are some significant differences between the individuals who have sustained their amputations while employed in armed conflict and those that are treated within an Australian context. The American service personnel are physically very fit and this has an impact upon their rehabilitation potential and their goals and expectations. Their experience of polytrauma (for example, accompanying spinal injuries, burns, visual deficits and hearing...
impairments) also impacts upon the rehabilitation process and their use of specific assistive technology. They also have access to significant financial support and therefore their ability to access and utilise advanced prosthetic technology and assistive technology is greater than many Australian upper limb amputees. Therefore, at times, I shall intentionally distinguish between military and civilian amputees within this report.

I would like to state that the focus of this fellowship was on adults with upper limb amputations or deficiencies and, although I visited a number of centres that treated children and adults, the reflections in this report and the associated recommendations apply mostly to individuals aged 18 and over.

Whilst I was fortunate to visit two of the major military amputee care facilities in the USA during my Churchill Fellowship travels, I also had the privilege of visiting a number of international centres that are providing services to people with upper limb amputations of a nature similar to those in Australia. The boy who had his hand amputated in a bean grinder in South America; the man who had lost his arm as a result of an electrical burn injury at work; and the woman who lost her arm in a traffic accident on an icy road. In every facility that I visited the clinicians were asking the same questions:

• How can we assess our clients most effectively?
• Could we be offering better therapy?
• Are our international colleagues doing things similarly or differently to us?

Advances and challenges in rehabilitation services for people with upper limb amputees were observed in a range of areas – the influence of surgery upon rehabilitation outcomes; the challenge of thorough assessment; holistic therapy approaches; and prosthetic prescription. The remainder of this report will be organised around these four themes.

5. SURGICAL TECHNIQUES

During this Churchill Fellowship trip I had the opportunity to learn about some of the additional surgical options that can influence the rehabilitation outcome for people with upper limb amputations. Some challenges in maximising prosthetic outcomes for upper limb amputees are related to problems in suspending the prosthesis from the body or in controlling the various movements of the prosthesis. The commitment of some specific groups of surgeons, specialists and researchers has led to alternative solutions which can significantly influence outcomes.

5.1 Osseointegration for limb amputation

For over a decade, Dr. Rickard Brånemark (M.D., Orthopaedic Specialist) from Gothenburg, Sweden has been advocating for direct anchorage of the prosthesis to the skeleton using titanium implants. Initially this work was pioneered in the dental arena by his father, Professor Per-Ingvar Brånemark, but Rickard has continued research and development in lower limb amputees and, more recently, upper limb amputees. To date Mr. Branemark and his team have completed approximately 130 cases of osseointegrated limb surgery, about 30 of these are in the upper limb. I visited with the team at Sahlgrenska Universitetssjukhuset (Sahlgrenska University Hospital) in Sweden to learn more about the procedures involved.
The procedure occurs in two stages. The first stage involves insertion of a fixture into the medullary cavity of the residual bone which is left unloaded for 6 months. At the second stage surgery a titanium abutment is inserted into the distal end of the fixture and is left penetrating the skin. It is onto this abutment that the prosthesis can be securely suspended. Further information can be found at www.integrum.se.

I was very fortunate to attend a second stage lower limb surgical procedure while in Gothenburg but, given the focus of this fellowship was on rehabilitation advances for upper limb amputee, I was particularly interested in the nature of rehabilitation following this procedure. Unfortunately there were no upper limb amputees with osseointegrated prostheses in the clinic during my visit, but valuable time spent with and Stewe Jonsson (Prosthetist / Orthotist) revealed the following points about transhumeral patients who have had osseointegration surgery:

- It is important that the patient realistically judges and reports pain levels. A visual analogue scale for pain of 0-10 is used (with 0 = no pain and 10 = extreme pain). Patients are advised to maintain activity limits so that they never experience pain above their subjective level of 4.
- Following stage 2 surgery, the patient commences with gentle exercise, slowly increasing shoulder range of motion.
- Application of weight on a short training prosthesis generally commences at week 4 post stage 2 surgery, and weight is increased slowly on a weekly basis until at three months they can commence wearing a lightweight cosmetic/passive prosthesis.
- Increased loading on this prosthesis occurs slowly until the weight of an active prosthesis can be tolerated and the surgeon gives permission for the patient to utilise such a prosthesis.
• Individuals need to recognise that a significant time commitment is required to build up loading without compromising healing.
• Infection continues to be a risk and patients often experience one superficial infection each year.

5.2 Targeted Muscle Reinnervation
The staff at the Rehabilitation Institute of Chicago / Northwestern University (RIC/NWU) have pioneered Targeted Muscle Reinnervation (TMR) surgery. This procedure involves completing nerve transfers using the residual nerves from an amputated limb and transferring them onto alternative muscles. The aim of the surgery is to elicit strong electromyographic (EMG) signals which can be detected by surface electrodes and utilised to operate the functions of a prosthesis in a simultaneous manner. A second benefit of the surgery that has been performed at RIC/NWU is the discovery that sensory feedback may also be enhanced and therefore targeted sensory reinnervation is also considered.

It is important to note in this report that the RIC/NWU are not the only team developing this surgery, there are other teams within the USA and Europe who are carrying out and developing similar procedures. However I was able to personally witness the outcomes of TMR surgery at both RIC/NWU and Brooke Army Medical Center (BAMC) as well as attend two presentations at the Skills for Life II conference in Denver as part of my Churchill Fellowship travel. In particular the days I spent with Kathy Stubblefield (Occupational Therapist), Robert Lipschutz (Prosthetist), Blair Lock and Levi Hargrove (Research Engineers) in the research laboratory at RIC/NWU greatly enhanced my understanding.

Some of my key learnings about TMR include:
• Whilst the TMR team have presented their initial work at a number of international forums and have published their work in a range of research journals, my time at RIC / NWU highlighted that this surgery is no longer considered solely as a research initiative but is now more readily available to the broader upper limb amputee community.
• There are some challenges in the uptake of surgery for those patients with higher level amputations who have become accustomed to not wearing a prosthesis.
• Patient and clinician engagement in this process requires persistence and patience as it may take around 3 months to detect initial contractions and then further therapy to increase the strength of the muscle contractions.
• Once initial contractions are detected therapy should be aimed at encouraging the patient to engage in maximal contractions within gross movement patterns. This endeavours to build strength in the re-innervated muscles.
• Once there is a relatively consistent response to the patterned exercise, therapy should focus on contracting each target muscle in isolation to develop control of discrete prosthetic movements.
• Development of prosthetic operation often progresses through the following stages:
  o Slow independent sequential control
  o Faster independent sequential control
  o Intentional simultaneous control
  o Spontaneous simultaneous control
Current research at RIC/NWU includes projects furthering the use of pattern recognition and the use of virtual reality clinical tools for training.

For an illustrative case study please refer to:

5.3 Bone Lengthening
I attended a particularly interesting presentation by Mr. Ronald Hugate (Orthopaedic Surgeon) and Mr. William Brown (Plastic / microvascular surgeon) who work at The Denver Clinic for Extremities at Risk, Colorado (http://www.thedenverclinic.com). They presented their work in bone lengthening to increase residual limb length with benefits for prosthetic suspension and control.

One of the key similarities between each of these teams is the close relationship and positive communication between the surgical team and the associated rehabilitation professionals (i.e. prosthetists, occupational therapists, physiotherapists and rehabilitation engineers). Opportunities for team discussion about the issues facing each individual patient and the expected outcomes as well as prosthetic options appears to play an important part in achieving the final result of enhanced participation in daily activities and life roles.

6. THE CHALLENGE OF ASSESSMENT
One of the challenges facing clinicians and researchers who work with upper limb amputees and prosthetics is to objectively measure the functional effectiveness of a prosthesis, and the extent to which an individual utilises their prosthesis as they participate in their life roles (Kyberd & Hill, MEC 2008). Many assessments of upper limb function cannot appropriately evaluate the effectiveness of a prosthesis that has limited degrees of function. Often clinicians use tools such as subjective checklists to evaluate a patient’s competence with their prosthesis.

Over the past three years there has been a greater awareness by individuals who work in the area of upper limb prosthetics of a need to enter into dialogue with their international colleagues about assessment methods. There is a general acknowledgement that, while different assessments suit the needs of various groups (eg. researchers, engineers & clinicians) it is useful to identify a “toolbox” of standardised measures that could be used across a variety of centres and countries in an effort to facilitate a comprehensive and comparable approach to assessment.
Information about assessments that was gathered during my Churchill Fellowship travel and is particularly relevant to occupational therapists is as follows:

- A working group known as the Upper Limb Prosthetic Outcome Measures (ULPOM) group has been formed and has reviewed 35 existing assessments and rated their suitability for use within adult practice, paediatric practice and prosthetic research / development. Australian clinicians have an opportunity to engage in this process and provide an Australian perspective by accessing a web-based “Google group”. The coordinator for this is Shawn Swanson who can be contacted by email at sswanson@armdynamics.com.

- The Assessment of the Capacity for Myoelectric Control (ACMC) is a relatively new assessment developed by Dr. Liselotte Hermansson in Orebro, Sweden. This standardised clinical assessment measures a person’s ability to operate a myoelectric prosthetic hand within the context of a personally selected bimanual task. Training courses for this tool are being conducted by the developer and further research into identifying common suitable tasks and rater calibration is currently being conducted. This assessment has the potential to refine a clinician’s observation of patients’ capacity to utilise the myoelectric prosthetic hand and is forming part of some clinicians’ regular assessment process.

- The Box and Block test is an assessment that was utilised in a number of facilities that I visited but this seems to be employed mostly as a training tool for basic grasp and release rather than be used for assessment purposes. When it is used in a standardised manner it must be remembered that the presence of a prosthetic elbow will also impact upon the score and therefore the assessment is best used to compare performance and change in the same individual over time.

- Assessment of driving performance following upper limb amputations continues to be an important focus for specialised occupational therapists. Some occupational therapy driving assessors in military facilities had access to sophisticated virtual reality systems that enabled them to assess reaction times but also provided subjective feedback about the impact of post-traumatic stress disorders and psychological reactions upon an individual’s capacity when driving.

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Assessment of capacity for return to work was also a focus of some of the centres, particularly within a military context. Clinicians in some environments had access to various parts of the VALPAR component work samples and the VALPAR Joule functional capacity evaluation system. These assessment tools enable clinicians to evaluate an individual’s ability to carry out a range of tasks including lifting & carrying, manipulating, moving through and holding a range of positions.

The importance of having a team approach to assessing individuals with upper limb amputations and determining best prosthetic prescription is being more broadly acknowledged within the field. It is timely that greater attention is given to providing therapists (other than prosthetists) with specific training about new prosthetic components and technology that may be used in assessment and training to maximise patient outcomes. For example, when assessing patient suitability for fitting a myoelectric upper extremity prosthesis, one of the tools commonly used is a myoelectric tester (myo-tester). Myo-testers are used to determine the extent of independent muscle contraction and relaxation and to measure the EMG in a muscle. They are available from a number of suppliers and some of these suppliers now provide dedicated training for occupational therapists. One such company is Otto Bock – and they have developed on-line learning resources that can be found at: http://academy.ottobockus.com/courses/upper_extremity/ue_learning_series.aspx

Increased commitment to educating all team members about components will contribute to enhanced patient outcomes.

The importance of reassessment and ongoing follow up by a rehabilitation team cannot be underestimated. This is particularly as the person with an amputation ages, changes roles and new prosthetic technology becomes available. Different strategies may be required, new technology may increase capacity to perform various tasks and the musculoskeletal changes associated with amputation should be monitored carefully over time.

7. THERAPEUTIC TECHNIQUES

Many of the therapeutic activities and rehabilitation principles employed by the centres that I visited were similar to those already in practice within an Australian context.

Clinicians spoke of:

- Ensuring that the patients and parents (and clinicians!) clearly understand the prosthetic components and how they operate.
- Gaining skills in basic grasp, release and stabilisation (hold) with the prosthesis and being able to complete these actions in a smooth and spontaneous manner throughout a variety of positions and heights.
- Integrating the basic skills into daily activities where the cognitive challenge is increased and spontaneous capacity to use the prosthesis can be assessed.
- The importance of building confidence in the prosthesis by engaging in repetitive tasks and then through varied tasks.
- Recognising the importance of postural stability, strengthening, flexibility and aerobic capacity which can be enhanced through a physiotherapy program. These can also minimise cumulative trauma or overuse injuries of the upper limbs, neck
or back. These concepts are important for every upper limb amputee but essential for those with bilateral upper limb amputation.

- Supporting change of hand dominance, particularly in handwriting, if appropriate and also one handed keyboarding skills.
- Commencing myo-site training within a relaxed environment and with a relaxed posture.
- Building myo-site strength and endurance over time through a structured program.
- The importance of supporting family and friends throughout the rehabilitation process, recognising the important role they play in ongoing psychological well-being. This includes assisting patients to develop new social networks if required.
- The role of motivation and hope within the therapeutic process – encouraging people to look to the future and to develop their full potential rather than “just be mediocre”.

In addition, there were some approaches which might be further considered within my own practice as well as possibly in other Australian centres:

- Use of recreational technology such as the Wii™ at the commencement of treatment sessions to “warm up” the body, enhance alertness and increase postural control.
- More intentional consideration of using superficial heat (hot packs) to increase circulation, reduce pain and muscle spasm prior to myo-site training sessions once the residual limb is healed and inflammation is resolved.
- Greater consideration given to assessing and improving safe lifting and carrying capacity with the prosthesis through a structured graded activity and conditioning program.
- Enhanced awareness of new technology including: voice recognition technology (eg. Dragon NaturallySpeaking, J-Say Pro), Computer screen readers (eg. JAWS for Windows) – which could be useful for upper limb amputees as well as those people who have associated visual impairments.
- Incorporation of mirror box therapy – This therapeutic technique was originally described by Professor V.S. Ramachandran and has been adopted for use with...
certain patients who experience phantom limb pain. While simultaneously moving both the affected limb and the remaining intact limb, the patient watches the reflected movement of the intact limb in a mirror. Observations during this trip showed that in some centres this approach was used with the occasional patient who presents with longer term phantom limb sensation, in other centres efforts were made to employ this approach with all upper limb amputees from an acute stage.

- The use of therapy dogs within rehabilitation settings. Therapy dogs were observed at WRAMC and feedback from the servicemen within this environment reinforced the role they play in individual psychological adjustment and normalisation of the treatment setting.

- Greater awareness of techniques and strategies that may be helpful for those individuals with bilateral or multiple limb amputations. These are patients with very specialised needs who often require increased equipment and innovative problem solving. DVD’s from the Skills for Life II conference in Denver, Colorado, USA provide some guidance for clinicians who have had limited experience in this area and the EX-Center in Stockholm, Sweden (www.ex-center.org) also has a range of resources.
8. PROSTHETIC CHALLENGES AND DEVELOPMENT

The human hand is extremely intricate and cannot easily be replaced by currently available prosthetic technology. The design of the prosthesis and its functionality frequently has an influence upon an individual’s ability to complete their daily activities such as self care, work or leisure. Researchers and clinicians continue to dedicate efforts towards such areas as designing new terminal devices (eg. hands and hooks), improving suspension options, investigating novel control strategies, and enhancing cosmesis with the hope of improving prosthetic design and function for people with upper limb amputations.

My discussions and observations during this fellowship travel highlighted some particular challenges in the current upper limb prosthetic arena and also some efforts to address these challenges.

- The release of the Touch Bionics i-LIMB hand has added a new dimension to the available prosthetic terminal devices (hands) available on the market. Information can be found at [http://www.touchbionics.com](http://www.touchbionics.com). The i-LIMB hand has individually powered digits, a range of grip patterns and the ability of the hand to conform around items as it grasps them. Conversations with a range of clinicians and patients who had experience with the i-LIMB hand raised a number of issues which Touch Bionics are addressing as they are able. These issues include:
  - the need for an increased pinch force between the thumb and index finger,
  - increased robustness in the overall construction,
  - developments in the glove to reduce friction and maximise range of motion,
  - availability of different sized hands particularly to accommodate females
  - the need for a graphic user interface that enables some individual customisation by the prosthetist.

- Individuals with partial hand amputations / deficiencies continue to be a group who present significant challenges in fitting and limited prosthetic componentry options. Efforts to design better suspension and increased grip forces with suitable cosmesis are being actively pursued by Chris Lake (Prosthetist – Advanced Arm Dynamics), Jack Uellendahl (Prosthetist – Hanger Prosthetics & Orthotics) and Touch Bionics (through the development of ProDigits which are being beta-tested currently).

- The use of silicon to improve the skin-socket interface of the prosthesis, for cosmetic restoration and increased suspension. A number of centres / manufacturers have developed expertise in the use of silicon over a wide range of applications or are actively pursuing how it may assist in solving existing problems. This may be one area in which it may be beneficial for specific Australian upper limb prosthetists to develop greater expertise.

- As mentioned previously in this report (see the section on Targeted Muscle Reinnervation), the efforts to further the application of pattern recognition as a means of controlling prostheses may open up further prosthetic options.
Innovative approaches to providing partial hand amputees with increased grip force.

With the funding that is currently being committed to areas of prosthetic development and brain interface technology, further developments are expected in the next few years. One of the challenges remains how to support our Australian clinicians in their endeavours to access information when the majority of advances are occurring overseas.

It is interesting to note that those injured service people who are being treated in the USA are fortunate to be fitted with a range of prostheses / terminal devices which they can then choose from when carrying out particular tasks. Most service people are now fitted with an Otto Bock DMC hand, Motion Control ETD or Otto Bock Greifer, a body powered prosthesis and, more recently, a Touch Bionics i-LIMB hand. They may also receive a specialised recreational prosthesis for use in specific activities. Current military research efforts include a comparison of the performance of different prostheses.
9. CONCLUSIONS

This Churchill Fellowship, supported by the Jack Brockhoff Foundation, focussed on current advances in rehabilitation services for upper limb amputees and the lessons that can be implemented within an Australian context. The fellowship reinforced that much of our practice in Australia is following similar principles to those in place in other centres around the world and links with these centres continue. We are assessing patients in a similar way and are actively questioning the most appropriate assessments to utilise. We are endeavouring to maintain our knowledge of prosthetic componentry and treatment approaches and incorporating these appropriately within patient care. We are endeavouring to maintain contact with patients and to re-evaluate them over time so that we can be responsive to changes in their physical health and role engagement.

I would identify the two biggest challenges for any Australian amputee service are (1) access to funding and (2) coordination of care by a specialised, knowledgeable and committed upper limb amputee team. These may also be the challenges for our international colleagues working in a similar area of clinical practice.

9.1 Funding:
Gaining access to funding for individual prostheses, treatment resources within facilities and educational support for clinicians continues to be challenging within an Australian context. At an individual patient level, many upper limb prostheses are expensive. This is especially the case for externally powered prostheses which might provide enhanced function for certain patients due to their higher grip force and lower shear force. At present, most public patients within Australia are unable to access government funding for externally powered prostheses due to the way that prosthetic funding schemes are set up. Those who receive funding through insurance companies (eg. as a result of work or traffic accidents) may be restricted in the type of prostheses and assistive devices that they receive and in receiving appropriate and timely assessment. Current funding structures then limit access to timely provision of appropriate prostheses and training. This in turn affects a person’s ability to complete a range of activities throughout their day and may restrict their ability to reach their potential. It would be timely to consider a national approach to these challenges.

Certainly, philanthropic funding makes a valuable contribution at times and during this fellowship I observed the benefits of this funding stream, especially in the USA. At an amputee service level, being able to access the necessary funding to provide high quality working environments and a range of treatment resources including current technology has a positive impact upon both the clinicians and patients at those services.

In terms of maintaining currency of knowledge and skill, in order for Australian clinicians to keep abreast of developments in this area they often need to attend conferences and meet with colleagues overseas which is expensive. To date this has often been funded by the individual’s themselves and may not be sustainable. Certainly the advent of more web-based discussion groups and on-line education has assisted somewhat in supporting clinicians to be active in their field and to keep up to date. However, if Australian patients with upper limb amputations are going to continue to receive a “best practice” service, consideration should be given to how
funding and education can be provided to clinicians to assist them in maintaining a level of knowledge equivalent to their international colleagues.

9.2 Consideration of specialised teams in centres of excellence:

It is clear that Australians with upper limb amputations require a dedicated team of practitioners with a particular degree of knowledge in order to get optimal care. The range of issues facing individuals with upper limb amputations (including: surgical management, often protracted healing, pain management, physical changes, prosthetic prescription, one-handed functioning or no-handed functioning in daily activities, psychological adjustment, employment restriction and carer strain) can best be dealt with by a team with specialised knowledge and experience who can also support other amputee centres.

One of the challenges within the Australian context is that there are a small numbers of upper limb amputees spread over a wide geographical area and therefore clinicians may only come into contact with one of these patients on an occasional basis. As a result clinicians may not have current knowledge or sufficient skill to provide excellence of care to these patients. International experience suggested that when patients are managed by specialised multi-disciplinary teams with current knowledge and ongoing experience there is increased likelihood of positive outcomes. In many facilities visited during this Churchill Fellowship, those multi-disciplinary teams consisted of clinicians who were co-located and therefore care was provided in an integrated way which enabled a direct flow of communication, comprehensive care planning and immediate intervention as issues arose.

It may be useful for us to identify clear National Centres of Excellence in Australia for people who have upper limb amputations where care can be coordinated. Further consideration needs to be given to how these might operate but options could include:

- Patients attending an identified specialised service for a specified length of time for prosthetic assessment, prescription, fitting and initial training.
- Interfacing with a local therapy provider (e.g. community rehabilitation service) and prosthetic service to support the patient to integrate their prosthesis when carrying out their daily roles and activities – with support from the specialised centre including focussed education and information provision.
- Use of teleconferencing facilities with the local service and patient for ongoing follow up and review.
- Use of teleconferencing facilities for support with initial assessment and treatment planning with a local team manufacturing the prosthesis and providing therapy where existing skills are available.
- Use of a satellite service model where an experienced team attends local areas to conduct clinics and provides intensive manufacturing / training programs which can be completed by local clinicians.

To further ensure that these skills and knowledge areas are not lost, there needs to be an ongoing commitment to providing education about upper limb amputees and their management. This education should continue to be provided to rehabilitation trainees, rehabilitation fellows, prosthetic students and occupational therapy students. Efforts should also be made at specific facilities to address succession planning and knowledge transfer in Australia as some clinicians near retirement age or leave this area to pursue other work opportunities.
10. RECOMMENDATIONS

To continue improving the rehabilitation services offered to upper limb amputees it is necessary to:

- Foster ongoing positive relationships between surgeons at the acute hospital and members of the rehabilitation team, so that information regarding developments in amputee management and prosthetic technology can be shared.
- Engage in the international discussion about appropriate assessment tools and methods for measuring outcomes.
- Access information and education about current prosthetic developments, new technology and enhanced therapeutic techniques and integrate them into existing patient care where feasible.
- Share information about available resources to patients with upper limb amputations so that they can develop networks with other people who have limb loss, access information about new developments and be empowered in their decision making.
- Develop some electronic resources and education materials to reflect the Australian experience
- Provide an environment of hope and positive possibility within realistic limits.
- Liaise with international colleagues to share successful outcomes and engage in problem solving – this can be enhanced by use of electronic means such as discussion forums.
- Actively provide feedback to manufacturers and suppliers about the functionality of componentry that they develop as opportunities arise.
- Continue a system of intentional long term follow up of patients to enable appropriate response to change over time.
- Challenge existing funding structures and explore opportunities to educate funding bodies about benefits of new and existing technology & techniques for clients with upper limb amputations.
- Explore the possibility of establishing a model of specialised teams in centres of excellence for upper limb amputees.

10.1 Implementation / Dissemination

I will be incorporating the information gained from this fellowship into the Clinical Management of Upper Limb Amputees course to be held at Caulfield Hospital in March 2009, as well as undergraduate teaching provided to the National Centre for Prosthetics & Orthotics, and the Schools of Occupational Therapy at La Trobe University, Melbourne and James Cook University, Townsville. I shall share this report with other Australian occupational therapists who are working with upper limb amputees so that the information is actively shared with other Australian clinicians. I will endeavour to support my colleagues at Alfred Health to utilise the information gained about surgical advances, therapeutic approaches and prosthetic options when planning specific patient management.

I will remain as the convenor of the International Occupational Therapy Amputee electronic list-serve which will enable me to maintain and extend my international links and to share this report with international colleagues. I am also going to pursue a Doctor of Clinical Science (Occupational Therapy) with a research project into the experience of returning to work following upper limb amputation.

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As a result of this Churchill Fellowship I am going to be more active in international discussions regarding assessment tools and processes. I will trial a more systematic approach to assessment in my own practice and share the experience of this with other clinicians.

One of the most important contributions I believe that I can make, though, is to share my observations and experiences with the people who have upper limb amputations themselves so that they can be informed and educated about new developments, possibilities and ongoing challenges. In this way I can assist people to be empowered to participate in decision making regarding their own care.