Report by Sheridan Flint

2009 Churchill Fellow

The assessment and rehabilitation of complex adult cochlear implantees – UK, Denmark, Germany

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Signed Sheridan Flint Dated March 3, 2010
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Introduction

The receipt of a cochlear implant (CI) is a life-changing experience for patients and their families. As an audiologist, I observe how a patient’s world can be opened and rediscovered with greater access to sound after receiving a CI. While CI technology constantly improves, it cannot return a persons hearing to ‘normal’ or sound ‘natural’. It is an extremely personal and confronting experience for patients to adjust to hearing through a CI. The purpose of this Fellowship is to examine the assessment and rehabilitation methods that are currently employed in the United Kingdom (UK), Denmark and Germany to manage complex adult CI patients with a view to enhancing counselling and selection of appropriate patients and provide them with effective rehabilitation and post-operative support.

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- Dr Christopher Lind, Course Coordinator Master of Audiology, Flinders University
- Mrs. Kathleen Holland, Principal Audiologist, Flinders Medical Centre
- Mr. Robert Morrissey, Ear Nose and Throat Surgeon, Flinders Medical Centre
- Mr. Tony Marciano, Senior Audiologist, Women’s and Children’s Hospital
- Mrs. Liza Ricote, 2008 Churchill Fellow

Executive Summary

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The assessment and rehabilitation of complex adult cochlear implantees – UK, Denmark, Germany

Highlights:
- British Academy of Audiology Annual Conference, Liverpool, UK
- Yorkshire Cochlear Implant Service, Bradford, UK
- National Biomedical Research Unit in Hearing, Nottingham, UK
- South of England Cochlear Implant Centre, Southampton, UK
- CI Centre Vest, Århus Universitetshospital, Denmark
- Medizinischen Hochschule Hannover and Hörzentrum Hannover, Germany

Recommendations:
- Continue to promote to key stakeholders the value of a team approach to service provision
- Encourage the inclusion of speech pathology and psychology as allied health team members of cochlear implant teams
- Development of and improvement in communication and motivation assessment protocols
- Continue to investigate the benefit of objective assessment of auditory pathway integrity through PET and fMRI in conjunction with promontory stimulation
- Encouragement for the development of aural rehabilitation programs for patients including improved structure of individual appointments and the development of group activities as appropriate to the needs of the patients

Implementation and Dissemination:
- Discuss experiences with cochlear implant colleagues in South Australia
- Oral presentation and Poster presentation at the Audiology Australia XIX National Conference, Sydney, 2010
- Dissemination of information through the South Australian branch of the Audiological Society of Australia and publications related to the Audiological Society of Australia
- Ongoing advocacy for improved aural rehabilitation and assessment techniques for patients
Programme

17th – 19th November 2009
London, England
• Great Ormond Street Hospital
• The Portland Women’s and Children’s Hospital
• Guys and St Thomas’ Hospital

24th November 2009
Manchester, England
• Manchester Cochlear Implant Programme

25th – 26th November 2009
Liverpool, England
• British Academy of Audiololgy Annual Conference

30th November – 1st December 2009
Bradford, England
• Yorkshire Cochlear Implant Service

3rd December – 4th of December 2009
Nottingham, England
• Nottingham Cochlear Implant Programme
• National Biomedical Research Unit in Hearing
• The Ear Foundation

7th December – 11th December 2009
Southampton, England
• South of England Cochlear Implant Centre
• Advanced Bionics

15th – 18th December 2009
• Denmark
• CI Centre Vest, Århus Universitetshospital
• Høreafdeling, Århus
• Ida Institute, Copenhagen

21st – 22nd December 2009
Hannover, Germany
• Medizinischen Hochschule Hannover
• Hörzentrum Hannover
• Cochlear GmHb
The cochlear implant was first used to treat adults with severe-profound sensorineural hearing loss in Melbourne, Australia in 1978 (Dowell, 2008). The first CI surgery was performed in South Australia in 1985. Since this time, more than 500 children, adolescents and adults in South Australia have received a CI, with 10 new public adult CI recipients emerging annually.

Flinders Medical Centre (FMC) is the host hospital for the South Australian Public Adult Cochlear Implant Program. The program is funded to employ audiologists and ear nose and throat (ENT) surgeons to assess patients and perform the allocated number of surgeries each year. Patients from across metropolitan and regional South Australia access the service in addition to patients from interstate who prefer to travel to South Australia for services or those who transfer post-operatively.

The patients are diverse in their demographic, geographic, audiologic, socio-economic, medical and psychosocial backgrounds. The client diversity noted would be familiar to other CI centers around Australia. While an individual’s audiogram will define the degree and nature of their hearing loss, it does not provide information regarding the patient’s speech perception abilities, communication abilities or their psychological state in coping with their hearing loss (Hogan, 2001; Lutman, Brown & Coles, 1987; Martin & Clark, 2003; National Institute for Health and Clinical Excellence [NICE]; Tye-Murray, 2004).

As such, a CI clinic “needs to work with the client beyond the bounds of speech perception tests and technological adjustments. Clinics need to engage with their clients as they seek to re-establish their lives, resolve family and personal difficulties, find useful employment and so on” (Hogan, 2001, p xiv). In essence, CI programs are charged with providing an efficient and effective service that
supports patients with varied and often complex needs. A multidisciplinary approach to service provision is clearly necessary.

**Assessment of Cochlear Implant Candidature**

As CI technology has advanced, criteria for candidacy and expected outcomes for recipients have expanded. The earliest CI patients were those with no measurable hearing or with scores of <2% for speech perception tests (Horn, McMahon, McMahon, Lewis, Barker & Gherini, 1991; Kirk, 2000; Tye-Murray, 2004; UK Cochlear Implant Study Group, 2004). According to current candidacy criteria, patients may well have residual hearing and score <40% in their poorer hearing ear and <70% in their better hearing ear on open-set speech perception tasks (Dowell et. al., 2003; Pedley & Giles, 2005).

Patient factors that tend to predict CI outcomes include the presence of residual hearing, length of profound sensorineural hearing loss, age of onset of their hearing loss, compliance with hearing aid use and cognitive intactness (Hamrouge & Worsfold, 2005; Luxford, 1989; Kirk, 2000; Pedley et. al., 2003; Pedley & Giles, 2005; Tye-Murray, 2004). Patients referred to a CI clinic with complicating factors such as an early-onset (prelingual) hearing loss or no measurable hearing in one or both ears, use of manual language, complex medical history, physical, psychosocial, cognitive, vision and communication impairments, require these areas to be appropriately addressed (British Cochlear Implant Group [BCIG]; Hamrouge & Worsfold, 2005; Kirk, 2000). This suggests the need for a holistic approach to assessment.

A multidisciplinary team is required to address the audiological, medical, psychological and communication needs and complexities experienced by some adult patients (BCIG; Falkenberg, 2007; Hogan, 2001; NICE; Pedley et. al., 2005). Surgeons, audiologists, speech pathologists and psychologists are recommended to form foundation staff of a CI program. Supporting team members should include social workers and rehabilitation specialists, such as
hearing therapists, where possible (Hull, 2001; Pedley & Giles, 2005). Mental health issues, particularly anxiety and depression are commonly associated with and exacerbated by hearing loss (Bess, Lichtenstein, Logan, Burger & Nelson, 1986; Hogan et. al., 2001; Ihara, 1993; Lutman et. al., 1987; Tye-Murray, 2004). The detection of and intervention for emotional disorders such as depression should be given priority. This allows the patient the opportunity to work through issues that are impacting on their psychological state, although these are not mutually exclusive to issues surrounding their hearing loss. Prelingually hearing impaired adults are a heterogeneous group. However, these adults often present with social immaturities and display difficulties such as impaired appreciation of the feelings and perspectives of people they are communicating with, tendencies towards impulsivity, irresponsibility and perhaps possess less flexible personalities (Tye-Murray, 2004). Allowing psychosocial issues to continue unaddressed may compromise a patient’s ability to problem solve and cope with challenges of adjustment to the CI (Pedley & Giles, 2005). This necessitates psychosocial support to CI programs, particularly given the individuals who access these services are the most hearing impaired members of the community.

In the current South Australian model, adult CI candidates are provided with thorough medical and audiological assessments. Communication assessments focusing on patient motivation and analysis of conversation skills are provided by an aural rehabilitation expert through Flinders University. However, this occurs only at the request of audiology staff where clinically indicated. No funding for psychology or social work support is currently available unless the CI recipient is admitted as an in-patient of the host CI hospital.

Consistent with the staffing recommendations by Hull (2001) and Pedley & Giles (2005), cochlear implant clinics visited in the UK, Denmark and Germany are funded to staff surgeons, audiologists and rehabilitation specialists. Additionally, all clinics visited during the Fellowship, employ either a speech pathologist or a hearing therapist (titled ‘pedagog’ in Denmark and ‘pädagogen’ in Germany). The
Guys and St Thomas' Hospital (GSTT), South of England Cochlear Implant Centre (SOECIC) and Nottingham Cochlear Implant Programme (NCIP) were observed to employ both speech pathology and hearing therapy staff. Programs in the UK were aware of the need for psychological support for patients in their CI programs. Consequently, the CI teams at Manchester Adult Cochlear Implant Programme and SOECIC employ a clinical psychologist. Where patients require psychology assessment and support at Great Ormond Street Hospital, The Portland Women’s and Children’s Hospital, Yorkshire Cochlear Implant Service (YCIS), NCIP and GSTT, referrals to the clinical psychology department at the hospital or a community psychologist is required. Multiple CI staff noted that, given the complexities surrounding cochlear implantation, greater benefit could likely be derived where a psychologist was involved directly with the CI program and who understood the intricacies of the patient population. Future funding of this would be a positive addition to their foundation CI staff.

A clinical psychologist position was recently funded at the CI Centre Vest, Århus, Denmark. This centre also has access to a social worker.

Conversely, these psychosocial services were not included at the Hörzentrum Hannover (HZH) (Hannover Hearing Centre), Germany.

**Assessment model from the UK**

Across the UK centers visited during the Fellowship, there exist clearly defined assessment pathways for CI candidates. However, the timing of appointments and use of individual and group settings varies between clinics. This variability is in part, the result of the commencement of the National Health Service (NHS) initiative ‘18 weeks’ referral to treatment pathway (NHS, 2008). This initiative stipulates that all patients referred to a NHS service must commence their appropriate treatment regime within 18 weeks of being referred by their general practitioner. As such, CI centers within the UK have developed centre-specific
strategies of providing CI candidate assessment and surgery within the 18 week period.

One CI program that has developed an innovative assessment protocol is the SOECIC. On receipt of a new patient referral, this centre allocates the individual to an ‘assessment week’. Over a period of one week, the patient receives all assessments that are relevant to establishing their candidacy for a CI. As of January 2010, the assessment period will extend to two weeks.

The current assessment week pathway commences with an initial audiological evaluation incorporating pure-tone audiometry, aided threshold testing and speech perception testing using the Predicting and monitoring Outcomes from Cochlear Implantation in Adults (POCIA) protocol (Medical Research Centre). Radiological assessment via Computerised Tomography (CT) scan and / or Magnetic Resonance Imaging (MRI) is completed in readiness for a surgical consultation.

Once audiological and medical candidacy has been established, the patient is assessed by a speech pathologist and / or hearing therapist as well as a clinical psychologist. The patient is therefore aware, either at the initial audiological and surgical consult (for patients who are not appropriate CI candidates) or by the end of the assessment week, whether they are likely to be an appropriate CI candidate.

This method of service provision is consistent with the purpose of the 18 Week referral to treatment pathway, which states that “a more holistic approach to care means prompt attention and more convenient appointments, which leads to less disruption to daily life and leaves patients with greater confidence in the health system. [The patient] will have a better understanding of what to expect from their treatment and care, and when to expect it” (NHS, 2008). The assessment week, or two week period is also consistent with the aims of
the 18 week referral to treatment pathway in relation to benefits to staff of medical programs, suggesting that it is “easier to plan and manage workload[s], resulting in more productive working time. There will be a better use of professional time, resulting in improved relationships, both between colleagues, and with patients” (NHS, 2008). Conversely, assessment appointments that are scheduled over a longer period of time may be of value to some patients. A more staggered assessment period allows for patient and family member reflection on new information and integration of this with their prior expectations and knowledge of cochlear implantation (Pedley & Giles, 2005).

Assessment model from Denmark

The CI Centre Vest, Århus Universitetshospital complete 90 - 95 CI surgeries per annum. This number includes children and adults, with both groups offered the opportunity to become bilateral recipients within the allocated funding. This clinic is staffed by ENT surgeons, audiologists and speech pathologists. Additionally, recent funding has been allocated for a clinical psychologist position. The centre is supported by the Høreafdeling (Hearing Institute), which provides pre-operative counseling, psychology and social work support to CI candidates. As such, a holistic approach is achieved through service collaboration.

Of particular interest was the centre’s recognition of the psychosocial aspect of patient assessment and rehabilitation. The centre is seeking a structured way of evaluating patient, family member or frequent communication partner’s (FCP) expectations regarding cochlear implantation and their perceptions on the patient’s adjustment journey following the receipt of their CI. They are considering the use of the Code-Müller Protocols (CMP) which may be applied to the hearing impaired patient population. The protocols require the patient and family or FCP to reflect on the following areas:

- Patients ability to do work
• Patients ability to communicate
• Patients ability to be independent
• Patients ability to socialise
• Patients ability to cope with disability related depression
• Patients frustration and embarrassment
• Patients ability to pursue hobbies
• Patients ability to speak to strangers and make new friends

The use of a structured tool such as the CMP provides useful information to all members of the CI team. It provides a forum for the candidate and their family to discuss with the CI team, a patient’s pre-implant communication abilities and areas of challenge as well gain insight into psychosocial aspects of their hearing loss. Clinics can use this information effectively by structuring aural rehabilitation around areas of defined need (Hogan & Code, 2001).

Assessment model from Germany

The CI team visited in Germany was a collaborative unit comprising staff of the Medizinischen Hochschule Hannover – MHH (Hannover Medical School) and the HZH. The centre is recognized as being the largest CI centre in the world, with more than 5000 adults and children having received a CI through this unit and with approximately 500 new recipients per annum. The centre is well funded with 14 medical practitioners working within the program. The team also comprises 8 pädegogen, 3 audiologen (audiologists), 14 ingenieure (engineers who perform the CI programming) and 9 audiometrie (audiometrists) (Hörzentrum Hannover, 2009).

Individual communication assessment

The role of the speech pathologist within a CI team is significant. The speech pathologist is able to delve deeper into the communication abilities of a patient
and gain information which cannot be gleaned from the initial hearing test. Whilst the speech pathologists refer to speech perception results obtained by an audiologist, such as the POCIA test battery for UK patients, speech pathologists are particularly skilled in assessing the following areas:

- Perceived difficulties of the patient in communicating at home, in the workplace and in a social context
- Auditory perception skills; speech sounds and environmental sounds
- Speechreading abilities
- Patient’s receptive and expressive language abilities and reading and writing skills
  - This is highly relevant when assessing complex patients who may have a prelingual hearing loss or a patient who has an acquired brain injury, such as that following a stroke
- Speech production skills including articulation, phonology, rate, stress placement, rhythm and fluency
- Voice quality, resonance and breath support for speech production
- Conversation skills and use of communication tactics
- Patient perception of their quality-of-life (QoL)
- Patient / family / FCP expectations of cochlear implantation
- Patient motivations towards cochlear implantation

Adult speech pathologists working within the UK programs that were visited, had assembled test batteries that allowed the investigation of the areas of voice, speech, language, communication, expectations and motivation. One particular assessment tool used was the Phonological Evaluation and Transcription of Audio-Visual Language (PETAL) (Parker, 1999). This tool provides the assessor with detailed information regarding the speech production patterns of the patient. Using this assessment tool, information is gained surrounding the patient’s phonetic and phonological patterns and suprasegmental features such as voice quality, pitch, intensity and intonation. The tool was designed to be used in the assessment of both children and adults, with any degree of hearing loss, where
the hearing loss has occurred at any stage in life (Hamrouge & Worsfold, 2005; Parker, 1999). The addition of such a tool to a CI program appears highly relevant given the volume of information available to the CI team.

Elderly patients are increasingly referred for consideration of a CI. This client group holds a unique set of complexities for CI clinics, as cognition, memory and processing issues typically arise. Consequently, a patient’s medical history, particularly any previous neurological insults are important issues that require close examination for their impact on the communication of the patient. Dexterity and psychosocial support networks are also important factors (Hamrouge & Worsfold, 2005; Luxford, 1989; Pedley et al., 2003; Tye-Murray, 2004). The CI teams at GSTT and SOECIC recognise this and are mindful that tools such as the Psycholinguistic Assessment of Language Processing in Aphasia (PALPA) may need to be utilised to obtain this information. The PALPA allows the clinician to assess a patient’s oral language (receptive and expressive) and written language (reading and writing) abilities and determine the impact of the neurological insult on this (Kay, Coltheart & Lesser, 1992). There exists a gap in such services and deficit of clinical information with the current structure of the South Australian Public Adult Cochlear Implant Program.

The development of a thorough communication test battery would be of benefit to CI centers in Australia when working with complex adult patients. This is particularly relevant to the South Australian Adult Cochlear Implant Program, as the program is hosted within the Department of Speech Pathology and Audiology, FMC. There are speech pathologists within the department who practice in the acute setting in the areas of voice, speech and language (Flinders Medical Centre Allied Health).

Furthermore, the Department of Speech Pathology and Audiology is combined with Flinders University. There are also academic members of staff with specialist knowledge in these complex communication areas. If the skill sets of
staff members who work with patients with acquired brain injury were to be utilised in collaboration with the communication assessment currently offered, the information provided to the CI team would be insightful, relevant and used very effectively within the clinical context of the CI program.

Additionally, the present Flinders University aural rehabilitation clinic is accessed by students of the Bachelor of Speech Pathology, Master of Speech Pathology and Master of Audiology, Flinders University. The development of a comprehensive speech pathology assessment and intervention team within the South Australian Adult Cochlear Implant Program would provide greater clinical skill development opportunities for students of all three programs.

Assessing patient expectations and motivations

Patients and their families present to a CI clinic with very individual expectations and understanding of the risks, benefits and potential outcomes of cochlear implantation. When working with adults with complex needs, it is essential that these preconceived ideas be discussed and the family unit or FCP progress to a realistic level of expectation of the device (Pedley & Giles, 2005).

Prelingually hearing impaired adults are one particular group of complex adults who present a challenge to CI clinics. Given that improvements in open-set speech perception tests (auditory alone) have been the measuring stick by which improvement and outcome success has been measured (Kirk, 2000; Luxford, 1989; Moody-Antonio, Takayanagi, Masuda, Auer, Fisher & Bernstein, 2005), counselling for these patients is highly individual. It has however been demonstrated that prelingually hearing impaired adults achieve benefit in auditory visual speech perception, improved environmental sound awareness and self-reported improvements with psychosocial aspects such as improved self-confidence and relationships with friends, family and work colleagues (Atkinson,
The use of a formal tool such as the CMP, as suggested by the CI team in Denmark, can enhance discussions between client, family and CI team members surrounding expectations of cochlear implantation (Hogan, 2001; Pedley & Giles, 2005). Checklists that raise discussion about the accepted benefits and limitations of cochlear implantation can be useful discussion tools, such as that developed by Pedley and Giles (2005). An adapted version of this is used to great effect by clinicians working within the South Australian Adult Cochlear Implant Program.

The Client Oriented Scale of Improvement (COSI) (Dillon, 2001) is another tool that can be used pre-operatively to determine patient goals for communication. Again, this is a tool currently used at the communication assessment session for patients of the South Australian Public Adult Cochlear Implant Program and could be implemented as a standard assessment tool for all patients within the program.

Assessment of patient motivation is pertinent to the establishment of CI candidacy and can be a complicated area to investigate. Although all members of the CI team contribute to building the clinical picture of a patient, the psychologist holds an important role in exploring patient motivation. They are also skilled in determining any patient-related factors that may impede candidacy such as deterioration in a patient’s cognitive function, depression or anxiety that is obscured by the presenting hearing loss.

The level of patient commitment to long term rehabilitation and towards ongoing monitoring requirements of the device must also be assessed. Issues regarding personal motivation in contrast to family motivation must be extrapolated (Hogan, 2001; Pedley & Giles, 2005). Often the motivation towards a CI appears simple; “a person is deaf - implants ‘fix’ deafness - I want an implant. Yet…the waters of
motivation are often muddied with other more complex issues” (Hogan, 2001, p 115). The benefit of a multidisciplinary team, as outlined by one UK clinic, was that each professional approaches a CI candidacy assessment from a different clinical perspective yet the patients are having similar information reinforced by each team member. It allows for a broader understanding of the patient and their motivation while also providing the patient with a consistency of information dissemination.

The Line the Box and the Circle (Ida Institute, 2009) is a motivational assessment tool adapted by the Ida Institute, Denmark for use by audiologists in determining a patient’s level of motivation for change in their hearing and communication status. It has been applied clinically in Denmark since 1990 in the areas of surgical and chronic disease for assessing patient motivation where lifestyle changes are necessary prior to and following a medical procedure. The purpose of the tool is to “coach patients into taking responsibility for their actions and making appropriate behavioral changes” (Ida Institute, 2009, p 1). This tool empowers patients to make statements surrounding their personal level of motivation towards making changes in their hearing and communication abilities and challenges their views on the reality of their circumstances (Ida Institute, 2009). A presentation by Bundesen, Gailey, Bramham and Whibley (2009) at the British Academy of Audiology Annual Conference, Liverpool highlighted this tool and its use was reinforced by Therese Velde, Ida Institute Audiologist when visited onsite in Nærum, Denmark. Staff training and the implementation of such a tool in a CI program would facilitate the team’s understanding of a patient’s level of motivation towards cochlear implantation. It would also serve to heighten the patient’s awareness of their thoughts and feelings on the device.

It is accepted that “auditory alone word and sentence recognition scores are not exclusively representative of how much a patient benefits from a cochlear implant” (Moody-Antonio et. al., 2005, p 652). The receipt of a CI has been repeatedly demonstrated to impact positively on quality of life (QoL) for the
recipient and their family members (Faber & Grøntved, 2000; Hogan, 1997; Horn, McMahon, McMahon, Lewis, Barker & Gherini, 1991; Knutson, Schartz, Gantz, Tyler, Hinrichs & Woodworth, 1991; Mo, Lindbæk & Harris, 2005; Pedley et. al., 2003). Clinics within the UK commonly perform pre and post-operative QoL measures of the CI patients. This is significant, particularly for clinics working with adults with complex needs, as QoL measures offer insight into broader patient outcomes. Consequently, QoL information provides guidance to clinicians and reassurance to the patient regarding changes in their functional communication ability that cannot be measured from speech perception tests.

**Group sessions within the assessment period**

The group setting is an efficient information dissemination setting for CI programs, particularly when large numbers of patients are being considered for cochlear implantation. It is also of value to clinicians as they are afforded the opportunity to make observations about patient interaction and communication skills, use of communication tactics and patient / family member interplay within an informal setting. Patients benefit from the experience through meeting other CI candidates and realising that other patients (and their families) experience the same difficulties. Patients may further benefit from listening to questions asked by other group participants and feel more relaxed than an individual appointment where the focus is directed solely towards them (Hogan, 2001; Pedley & Giles, 2005).

Group information sessions within the CI assessment period are used to great effect in numerous UK clinics. At the Manchester Adult Cochlear Implant Programme, group information sessions are held monthly for patients once they have undergone initial audiological and medical assessment and been found to be suitable candidates. Sessions are structured to allow the audiologist and hearing therapist to discuss the following:

- How natural hearing works
• How a CI works
• Demonstration of the internal and external components from each manufacturer
• Patient selection of their preferred manufacturer for their CI surgery
• Outline the hospital admission and likely length of stay
• Discuss expectations / limitations / benefits of a CI

A recent CI recipient attends the information group and speaks about their experiences. Group participants are then provided with the opportunity to ask questions of the patient and professionals. Refreshments are provided at the end of the session to provide another casual forum for candidates to ask any further questions. This model of information dissemination is also applied during the pre-operative period at YCIS and at SOECIC where speech pathologists are also involved in the group sessions. Attendance at the group information sessions is highly valued by the CI teams and is therefore compulsory. Individual sessions are arranged for patients with complex needs, such as those with other sensory or cognitive impairments and for patients who use manual language and therefore require a signing interpreter.

Australia has a very active peer support network in the Cochlear Implant Club and Advisory Association (C.I.C.A.D.A Inc.). Membership branches exist in New South Wales, South Australia, Queensland and Western Australia. Patients of the South Australian Public Adult Cochlear Implant Program are invited to meet a member of C.I.C.A.D.A. pre-operatively to gain insight into that individuals experience with their hearing loss and life following their CI. The C.I.C.A.D.A. member and CI candidate meet off campus independent of the CI clinic. Given that patients originate from both metropolitan and regional South Australia, this meeting can be difficult to arrange.

A group setting such as those held at YCIS or SOECIC, or the Peer Led User Support (PLUS) group of NCIP may overcome the geographical challenges of
Australian clinics. The PLUS groups are again, a compulsory attendance for candidates unless there are special needs or circumstances requiring an individual counselling session. Groups are held at The Ear Foundation, Nottingham and are facilitated by two CI recipients who have received training in the running of group sessions and peer support to CI recipients. A stenographer is always present and their typing is projected onto a large screen for all group participants to read and follow the oral discussion.

The volunteers' role is not to discuss technical or clinical aspects of implants, rather to provide personal stories regarding their hearing loss, their decision to proceed with a CI and their experiences post-operatively.

A family member of one of the volunteers is also available to provide an alternative perspective on the CI process. This is valuable, as family members and FCP are invited to attend the group.

The purpose of the group is to afford candidates the opportunity to ask questions that professionals quite simply cannot answer, including motivations for a CI, any surgical complications (i.e. pain, discomfort, balance disturbance) and what the device actually sounds like once activated. This peer led group may be an appropriate model for implementation in Australian.

**Medical imaging and promontory stimulation assessment**

One particular group of complex adults are those who present with no measurable hearing in one or both ears. Long periods of profound hearing loss can lead to auditory depravation and possible reorganisation of the auditory pathways in the brain (Hall, 2009). Where this occurs, the CI team seek to establish whether any functional auditory structures remain that may benefit from stimulation from a cochlear implant. This is of high importance during CI candidacy assessment given the decision to undergo cochlear implantation is a
significant one. Cochlear implant teams require accurate information for deciding on patient candidacy and counselling of patients. In turn, patients require accurate information to make their decision whether to proceed with surgery and commit to the rehabilitation requirements post-operatively (Luxford, 1989).

One method of assessing these patients is promontory stimulation, where a needle electrode is inserted through the ear drum and rested on the bony promontory separating the middle and inner ear. The ear is stimulated in a manner which mimics the electrical stimulation provided by a cochlear implant and patients are required to report their detection of either an auditory sensation or vibrotactile sensation or both (Luxford, 1989; Martin & Clark, 2003; Obler, Köstler, Weber, Mack & Becker, 1999; Mortensen, Madsen & Gjedde, 2005b; Schmidt, Weber & Becker, 2001). Consequently, promontory stimulation is a highly subjective procedure.

Furthermore, complex adult patients who have experienced a long period of profound hearing loss, cognitive, intellectual, vision or communication impairments face difficulties in understanding the task or in providing feedback regarding their perception of the electrical stimulation due to auditory depravation. The accuracy of their reporting of the electrical sensations can be questionable (Neumann, Preibish, Spreer, Raab, Hamm, Euler, Lanfernamm, Helbig & Kiefer, 2008; Obler et. al., 1999).

Given these clinical challenges, researchers in Denmark and Germany have sought objective methods of assessing the intactness of the central auditory pathways with these complex adult patients.

Researchers at Århus Universitetshospital, Denmark have combined promontory stimulation testing with positron emission testing (PET) to obtain objective measures of auditory pathway integrity in profoundly hearing impaired patients.
Researchers at MHH, Germany have performed promontory stimulation testing combined with functional magnetic resonance imaging (fMRI) to obtain objective measures from these complex adult patients.

These techniques provide images of the auditory pathways of the brain facilitated by changed to oxygen levels in the brain. Where PET achieves this by measuring reduced or elevated brain activity through changes to oxygen-15-labelled water ($^{15}$O) (Fahey & Badawi, 2007; Mortensen et. al., 2005b) fMRI achieves this by detecting blood oxygen level dependent (BOLD) contrast when neuronal activity occurs in the auditory cortex (Mettler, 2005; Wilkinson & Paley, 2008).

The work of Motensen et. al. (2005a; 2005b) suggests that transtympanic membrane promontory stimulation coupled with PET has value in examining whether the electrical signal stimulates the structures of the auditory cortex that are relevant to speech perception. They suggest that duration discrimination (temporal difference limen, TDL) is of greater value to promontory stimulation assessments than gap detection, as gap detection was found to stimulate the auditory structures below the cortical level. Both gap detection and TDL are used when performing promontory stimulation testing within the South Australian Public Adult Cochlear Implant Program. Current procedures may require revision and consideration of the incorporation of PET as an objective tool is also suggested.

The CI team and Department of Neuroradiology at MHH have begun to explore promontory stimulation testing coupled with fMRI. Lesinski, Littmann, Battmer & Lenarz (1997) have suggested that the use of a transtympanic needle electrode, such as that used currently by the South Australian Public Adult Cochlear Implant Program, is superior to the use of an ear-canal electrode during promontory stimulation testing. The ear-canal electrode appeared to increase the likelihood of a vibrotactile sensation to the CI candidate, which is disadvantageous,
particularly when assessing complex adults who have difficulty reporting their subjective perception of the electrical stimulation.

Three case studies of adult patients undergoing promontory stimulation testing in conjunction with an fMRI were reported by Schmidt, Weber & Becker (2001). The most interesting case outlined that of an adult with prelingual hearing loss and manual communication as their primary mode of communication. While subjectively the patient reported positive auditory sensations with their promontory stimulation, no cortical activation was measured within the primary auditory cortex during the fMRI. This allowed the CI team at MHH to appropriately counsel the patient about their expectations for a poor outcome with cochlear implantation given the results of this objective testing in addition to the audiological and communication assessments.

Again, discussion surrounding the clinical usefulness of promontory stimulation testing in collaboration with fMRI to the South Australian Public Adult Cochlear Implant Program appears appropriate. This is particularly relevant should a 1.5T magnet be available at the host hospital for research use. The practicalities of engineering of fMRI compatible equipment, software and clinical expertise also require addressing (Obler et.al., 1999; Schmidt et. al., 2001).

**Aural rehabilitation**

The development of an effective post-operative management program for CI recipients is of paramount importance to any CI centre, to enable patients to derive the greatest level of benefit from the device (BCIG; Falkenberg, 2007; Tye-Murray, 2004). The structure of aural rehabilitation programs within CI clinics has evolved, along with the technology. While auditory training programs are commercially available, CI recipients have needs that extend past traditional aural rehabilitation structures. Tye-Murray (2005) reflects that “much of traditional aural rehabilitation methodology that was developed for hearing aid users is
directly applicable to cochlear implant recipients, but...because cochlear implant recipients present unique needs and challenges...their needs vary greatly” (Tye-Murray, 2005, p x).

Cochlear implant patients have additional needs, as the sound stimulation through a CI is completely foreign to them. Time for adjustment and structured support is required. Prelingually hearing impaired adults have reported taking up to two years to adjust to their new sound stimulation (Atkinson et. al., 2006). Complex adult patients, including those with a prelingual hearing loss experience significant challenges in their adjustment to cochlear implantation. Each recipient possesses their own unique set of circumstances that need to be accommodated within a structured and effective management plan (BCIG; Falkenberg, 2005; Hogan, 2005).

**Individual aural rehabilitation**

All CI programs visited in the UK, Denmark and Germany possess well established post-operative rehabilitation programs in place. Programs are structured around the listening heirarchy of detection through to comprehension and feature both analytic and synthetic activities.

It is important to note, that each program demonstrates flexibility with regard to provision of services to adults with complex needs. For example, one hearing therapist at HZH, Germany was noted to temporarily discontinue analytic auditory training activities with a postlingually hearing impaired adult. There were psychosocial needs surrounding this patient’s understanding of the function of the CI and this was addressed by inviting the spouse into the clinic room. These non-auditory needs required attention before auditory training could proceed.
Conversely, extra emphasis was placed on analytic detection tasks with a prelingually hearing impaired adult as they required significant assistance with this level of auditory training at their switch-on aural rehabilitation appointment.

Also, a speech pathologist at YCIS was noted to continue aural rehabilitation with a complex young adult for two years post-operatively. This patient required ongoing auditory training and psychosocial support given the cognitive, speech production and psychological challenges surrounding the aetiology of the hearing loss.

This experience is in keeping with the reflections of Hogan (2001) who notes that “the cochlear implant addresses, to an extent, sensory loss. While such benefits are generally extensive, they are also varied. While many people, particularly in recent times, gain an enormous auditory benefit from the device, their psychosocial and family issues must be addressed” (Hogan, 2001, p61).

The aural rehabilitation program at the Portland Women’s and Children’s Hospital uses a combination or commercially available resources with that produced by CI manufacturers. Auditory training goals are devised using a combination of pre-operative communication assessment results and self-reported areas of difficulty as identified by the CI patient. Adult patients of this CI program often experienced geographical and language challenges, as many families travel from outside of the UK to access these services. As such, the CI team develops intensive individual rehabilitation plans that focus on therapy goals during the first month post-operatively.

The Manchester Adult Cochlear Implant Programme provides weekly hearing therapy support to all patients for six weeks post-operatively. Hearing therapy sessions are provided for one hour immediately following each weekly audiology programming session. Patients also receive a hearing therapy appointment at three months, six months and twelve months post-operatively, with any additional
appointments arranged as required. Family members and FCP are encouraged to attend as the hearing therapists feels they too benefit from individual feedback on their use of communication tactics with the CI recipient. Education of the family and FCP is viewed as equally important to the direct intervention with the patient, particularly when working with complex adults (Giles, 2005; Hamrouge & Worsfold, 2005; Pedley & Giles, 2005).

Aural rehabilitation goals are determined by examining POCIA results and determining areas of significant need. Commercially available auditory training programs are utilised to facilitate this section of aural rehabilitation. The hearing therapist also employs resources available from the CI manufacturers. A standard rehabilitation manual is supplied to every patient to provide them with structured home practice and supplement clinic activities.

The hearing therapist performs telephone training with patients and engages family and FCP in this activity also. Assistive technology is discussed with CI patients and demonstrated where possible and patients are counselled on where to access and purchase this assistive technology in the community.

Aural rehabilitation at YCIS is performed by a speech pathologist. Patients begin their aural rehabilitation sessions during their switch-on week and attend up to three sessions over this week. They are then seen at monthly intervals for three months. Where patients have complex needs, further rehabilitation regarding voice use, speech perception, communication skills and telephone use is arranged to maximise benefit from the CI. Again, aural rehabilitation resources are sourced from commercially available manuals and that provided by CI manufacturers. Independent home practice is encouraged through talking books and online resources.

The CI teams at GSTT, SOECIC and NCIP employ both speech pathologists and hearing therapists. Patients receive input from both specialists, with hearing
therapy sessions directed at sound awareness and detection, technology issues including telephone training, assistive listening device (ALD) use and confidence building through counseling and auditory training. Speech pathologists are responsible for tailoring aural rehabilitation programs relative to a patients speech perception and production skills and provide sophisticated rehabilitation for complex adult patients, such as those who experience communication difficulties extraneous to their hearing loss and those who demonstrate progress below that which was predicted pre-operatively.

Aural rehabilitation for adult recipients at Århus Universitetshospital, Denmark is provided by the Høreafdeling. This is of particular benefit to complex adult CI recipients as Høreafdeling also provide rehabilitation for cognitively impaired adults, such as those who have acquired brain injury. They also provide aural rehabilitation to hearing aid users. As such, the Høreafdeling staff are skilled in working with adult clients with a variety of complex needs. Aural rehabilitation commences at switch-on with the rehabilitationist from Høreafdeling attending the CI programming appointment. Counselling and initial auditory training commences at the switch-on appointment. Aural rehabilitation is provided twice weekly and continues as appropriate to the needs of each patient. Aural rehabilitation goals vary between patients, with tasks ranging from traditional auditory training though to music appreciation.

Where SOECIC hold their unique assessment week for CI patients, the HZH in Germany hold a switch-on week for adult patients. The structure of the switch-on week was developed as a result of the CI team recognising that improvements in the CI technology and changes to candidate criteria have resulted in patients achieving superior results in shorter periods of time. Patients are required to travel daily or reside in Hannover for a one week period to attend medical, audiological and rehabilitation appointments.
Complex adult CI recipients benefit from the intense week of rehabilitation as the standard auditory training program is modified for each patient and regular contact allows CI staff to effectively address medical and psychosocial complexities with patients and their family members.

**Group aural rehabilitation**

Aural rehabilitation groups are valuable forums for engaging CI recipients in discussion about psychosocial aspects of their adjustment to the device and perform auditory training where appropriate. The group setting allows CI recipients to share their experiences with one another, reduce the pressure often felt during individual rehabilitation sessions, reflect upon their perceived level of activity limitation and participation restriction and provide one another with opportunities to role-play and practice skills with unfamiliar communication partners (Hamrouge & Worsfold, 2005; Hogan, 2001; Hull, 2001; Tye-Murray, 2004). Group aural rehabilitation was valued by multiple UK centres as well as the CI centres visited in Denmark and Germany.

The YCIS team were strongly influenced by the work of Hogan (2001) relating to psychosocial approaches to aural rehabilitation for hearing impaired adults. This client-centred approach to aural rehabilitation diverges from the technology (the CI) and traditional auditory training goals. It “seeks to address, in the group-process particularly, issues of immediate concern to the client…the client-centred, psychosocial approach is not so much concerned with asking questions as with facilitating a personal change process wherein the client learns to work through the social and emotional barriers that prevent them from communicating effectively” (Hogan, 2001, p xv).

Hogan’s work provides structure to CI rehabilitation staff in identifying and exploring problems as reported by the CI patients and working with them towards resolving these problems and barriers to effective communication. By way of
example, the speech pathologist at YCIS holds ‘Managing Deafness’ workshops for CI recipients which are principally based on addressing psychosocial issues in order to enhance patient adjustment to life and communication following cochlear implantation.

The CI team at SOECIC have implemented rehabilitation groups surrounding voice use, tinnitus and CI accessory use. The ‘Using your accessories’ group was created as a patient was noted to have misused one of their external accessory cables. The clinic recognised the need for patients to clearly understand how to use their device and accessories in a safe manner.

Patients are invited to attend a one day of session on the effective use of their technology approximately 6 months post-operatively. Clinical specialists from the relevant CI manufacturers lead the initial information session. The second portion of the accessory use group is an interactive display that provides recipients with the opportunity to trial ALDs that are compatible with their CI. This is an interesting concept which may be appropriate to the Australian context.

By inviting an organisation to attend a session and display accessories and ALDs to patients, it eliminates the geographical challenges of the Australian CI patients when accessing multiple services and decreases motivational challenges which patients may experience when required to visit multiple sites to access assistance for their hearing impairment. Although the accessory use group does return patient focus towards the technology, it has proven to be valuable to the clinic in addressing these other patient needs.

The voice use and tinnitus workshops are also interesting additions to the rehabilitation program at SOECIC. They are also held over one day, with 3-4 sessions offered annually. Patients with significant hearing loss typically experience difficulty in monitoring their voice in terms of its intensity, pitch and
quality as auditory feedback is required to successfully achieve this (Hamrouge & Worsfold, 2005; Tye-Murray, 2004).

Following cochlear implantation patients may experience improvements in monitoring their own voice (Atkinson et al., 2006). However, structured intervention may still be required, particularly for adults with complex needs. The voice use group is facilitated by speech pathology staff and focuses on providing information regarding the anatomical structure of the larynx, health and lifestyle factors that affect the voice and encouraging monitoring of the voice through group activities. These activities are useful in bringing conscious attention to factors that impact on voice quality and health and encourage CI recipients to attend to new auditory cues available to them through their device (Hamrouge & Worsfold, 2005). The tinnitus workshop is collaboratively run by the hearing therapist and a psychologist. It provides basic information regarding tinnitus to patients as well as relaxation techniques that may be used to cope with the psychological and physical symptoms that may arise in patients disturbed by their tinnitus.

The hearing therapist at Great Ormond Street Hospital has collaborated with the psychology department to hold a group day for adolescents prior to their transferring to an adult CI program. The group focuses on psychosocial aspects of cochlear implantation and hearing loss. Similar to that held by SOECIC, one section of the day is dedicated to the adolescent’s awareness of environmental aids and ALDs. During the day, the participant’s hopes and dreams for the future are shared with group members. The psychosocial group ends with all members visiting a café and the adolescent’s being charged with the responsibility for effectively communicating with café staff and ordering their meals. This also demonstrates real-world skills in using their CI in a complex listening environment and allows them to implement strategies learned earlier within the group.
This group setting allows the CI team to explore multiple areas with the adolescent’s. They are able to provide counselling on psychosocial aspects of hearing loss including patient identity and self-perception. They are able to demonstrate to the patients the technology available to support them and also how they can implement communication strategies in challenging listening environments, thus providing a holistic program (Hull, 2001).

Psychosocial groups were also highly valued by the Høreafdeling team in Denmark. One particular aural rehabilitation group provided by Høreafdeling is held for CI recipients approximately 6 months post-operatively. This group uses role-playing, self-report and peer support to deal with issues surrounding hearing loss and cochlear implantation. Patients discuss their hearing loss, communication and listening skills post-implant, as well as discussion surrounding family and FCP perception of the patient following their implant. Høreafdeling rehabilitation staff explore emotion and identity issues with patients as they adjust to life as a person with a CI. Consequently, this group effectively engages CI recipients in reflecting on their hearing loss and encourages participants to determine their personal areas of challenge so they may begin to address these (Hogan, 2001; Hull, 2001).

During the switch-on week at HZH, Germany, patients attend one group rehabilitation session with the pädegogen. The session is structured around auditory training tasks. However, the pädegogen highlight that the value of this group setting is that patients are completing auditory training tasks with unfamiliar speakers. The group members all have a hearing loss and are all adjusting to their CI. Consequently, communication tactics are discussed and integrated into auditory training activities. The group also provides opportunities for peer support and information sharing between CI recipients. As such, they are also providing opportunities to discuss psychosocial aspects of aural rehabilitation.
Conclusions

The most significant issue emerging from this Fellowship is the commitment to and provision of a multidisciplinary CI team. This commitment was consistent across the UK, Denmark and Germany. While CI candidates within the South Australian Public Adult Cochlear Implant Program are funded to receive thorough audiololgical and medical assessment, there appears a gap in the funding of comprehensive communication and psychological assessment roles.

Communication assessment and rehabilitation support through Flinders University is exceptionally valuable to patients of the South Australian Public Adult Cochlear Implant Program and to students within the three tertiary education programs at Flinders University. It is however, a limited service and would benefit from further input from speech pathologists involved in the areas of voice and acquired communication disorders to collaborate and provide an assessment service that caters to the needs of complex adults referred to the CI team. There also exist exciting opportunities for expansion in the teaching of rehabilitation skills to speech pathology and audiology students and developing their awareness of the needs of complex adult cochlear implantees.

Support from a clinical psychologist would further benefit the patients and staff of the program. As more elderly and cognitively complex patients are referred to the service, the skills of a clinical psychologist in assessing the suitability of patients for a CI becomes necessary.

The use of objective communication assessment and medical imaging assessment tools was also highlighted by CI centres visited in the UK, Denmark and Germany. Discussion is encouraged between key stakeholders surrounding the clinical relevance and evidence for the use of these tools, particularly promontory stimulation testing with PET and fMRI.
Recommendations

The following recommendations are made in order to facilitate change in the provision of CI services to adults in South Australia and across the nation:

- Discussion between key clinical and academic stakeholders in the South Australian Public Adult Cochlear Implant Program regarding the findings of the Fellowship

- The sharing of knowledge obtained during the course of the Fellowship to audiology colleagues nationally through the following methods:
  - Oral presentation and poster presentation at the Audiology Australia XIX National Conference, Sydney, 2010
  - Dissemination of information through the South Australian branch of the Audiological Society of Australia and publications related to the Audiological Society of Australia
  - Cochlear implant clinician interest group

- Engage CI consumers where appropriate, particularly South Australian committee members of C.I.C.A.D.A. Inc

- Ongoing advocacy for improved aural habilitation/rehabilitation and assessment techniques for paediatric, adolescent and adult cochlear implant patients
References


