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- Today's physios have an awesome responsibility!
- Electromagnetic therapy: fact or fiction
- The three-way health partnership: ACC, the physiotherapist and the client.
- Nordic walking in Parkinson's disease.
- Employer's perspectives of physiotherapy graduates.
- Home-based stroke rehabilitation using computer gaming.
- The effect of lumbar posture on spinal loading and function of erector spinae.

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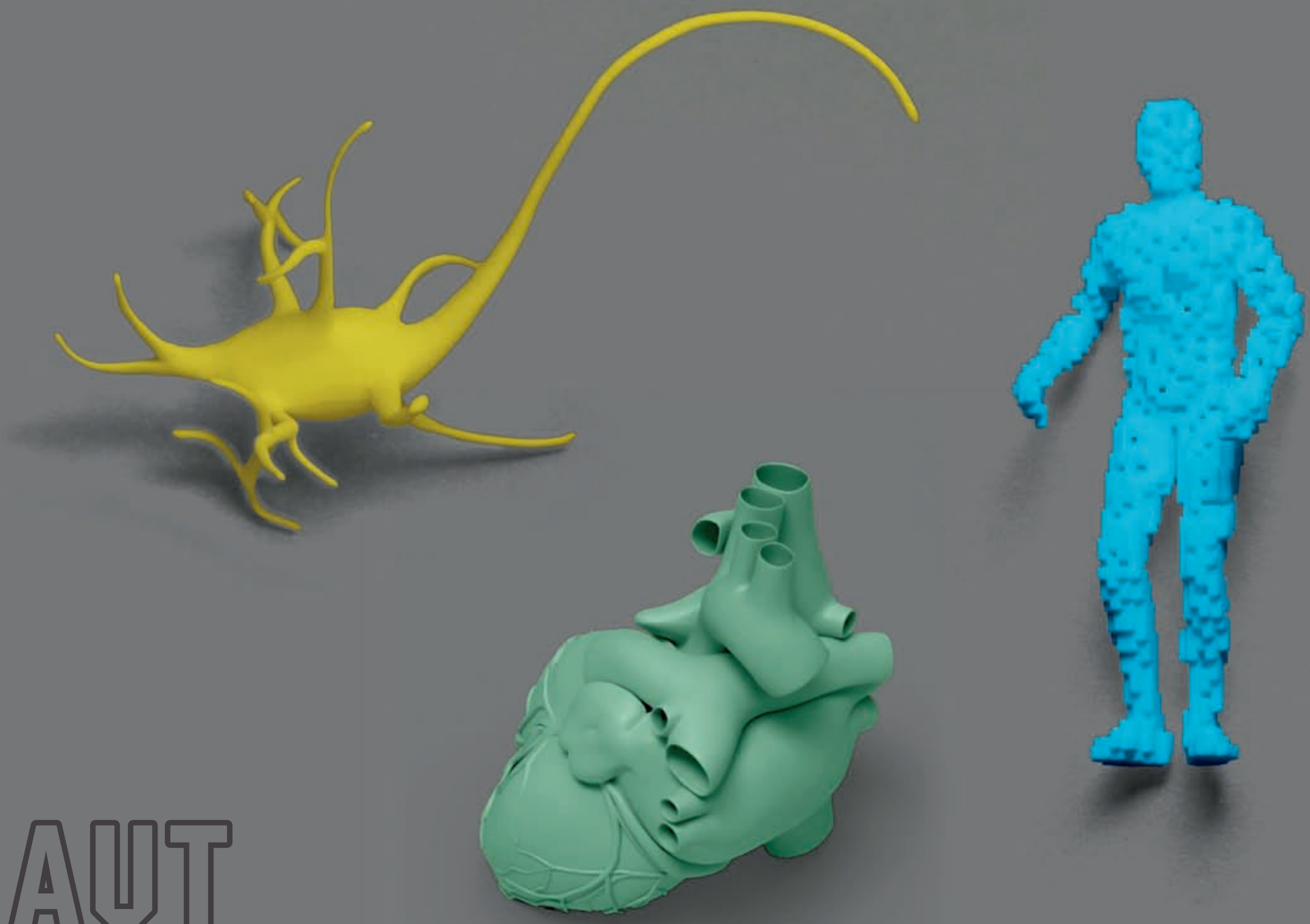
MOVEMENT FOR LIFE



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Photograph: Joggers in Hagley Park, Christchurch

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Today's physios have an awesome responsibility!

I hope journal readers will allow an elder to muse on the differences between when I graduated as a physio in 1957 and the practice climate of the 21st century. While the basic purpose of the profession has not changed, simply put, to habilitate or rehabilitate individuals to their fullest potential, the education, scope and manner of practice is vastly changed. These changes have made physiotherapy a far more exciting and challenging profession, with a diversity of career options. These changes however, also imply a greater responsibility.

We now live in a highly jargoned world, we dialogue rather than talk or discuss; we claim our practice is evidence-based, or best practice-based. We have dropped therapies, such as massage from physiotherapy education though many private practices around the world include a massage therapist. Although there was insufficient evidence to retain massage within the curriculum, it apparently is acceptable to include such a therapist within group practice. Also, while evidence for efficacy of electrotherapy remains weak, multi-technique therapy within one session is common. Clients often receive ultra-sound, acupuncture, traction, and interferential therapy, often with no posture, exercise or life-style advice. Is this evidence-based? Best practice? I think not and fear billing issues are governing some physiotherapy practice. There is that perennial problem of aligning theories of practice with actual practice and its financial needs.

The service physiotherapy provides should be unique and essential, and with proven effectiveness and efficacy. As Jette (2012) noted in his recent McMillan lecture, physiotherapy needs to focus on establishing what "works", rather than proving that physiotherapy is effective. Jette (2012) stressed the profession's need to widely use standardized outcome measures. It is also critical that clinicians use these measures as validated and not make minor changes that annul the ability to combine and compare results across multiple studies. Clinicians need to "not just talk the talk but to walk the walk" (Walker 2002).

In the mid-50s the curriculum contained 80 hours of massage. Physiotherapy textbooks could be counted on one hand; I do not recall using journals. There simply was no evidence other than anecdotal, for physiotherapy techniques and modalities although physiological effects were claimed. Physiotherapists, including academic faculty who spent most of their time teaching, conducted almost no research. The Chartered Society of Physiotherapy in Britain had commenced its Fellowship programme, which led to the development of early case studies that provided some basis for clinical practices.

Comparing then with now is rather like Rip Van Winkle waking up from his 30 years of sleep to find a totally different world. For example, there are now over 100 professional journals, increasingly available on-line. There is an abundance of textbooks on all aspects of the profession by physiotherapists. Sadly this abundance of reference material requires great vigilance by today's physiotherapists since many are poorly referenced, lack evidence for the described techniques or rely on secondary references. Sadly there is also an abundance of post-graduate/continuing education courses, where attendees often pay considerable fees but fail to challenge presenters for evidence of their approach, or investigate their credentials to be an authority on the topic. Back in the late 1950s and 1960s opportunities for further education were limited. We were, however, unlike current students, not taught to listen and read critically. Today's students are exposed to courses on research, evaluation of research, along with vital courses on health care law, and ethics. Day-to-day practice in the 21st century is infinitely more challenging and contains more inherent dangers and responsibilities.

The diversity of media sources, the ease by which therapists can quickly obtain 300, 600 or more references can be overwhelming and leads many to only read abstracts and inadequately scrutinize the study conducted. Hence there has been a rise in a body of literature to teach health professionals how to read different types of papers; to sort the wheat from the chaff, to determine what is worth reading and what should be discarded (Helewa and Walker 2000).

What were the career paths of the 50s? Most physiotherapists were in hospital practice, a few in private practice and physiotherapy education. Increasingly today, hospital outpatient departments are closed, and many more are employed in private practice. Entry-level education ranges from the baccalaureate to a professional doctorate, although the evidence for the ever-increasing higher degrees lacks rigor. The scope of current practice is enormous – ranging from frontline triage in the USA armed forces, physiotherapy diagnoses, first-contact practice, intra-articular injections, to name a few. The potential for malpractice has greatly increased and it is of interest that currently there is a debate on whether cervical manipulations should be abandoned by physiotherapy (Copeland 2012).

Current graduates face challenges we never considered. For us jobs were plentiful. Our main concerns were, where we bursary students would be sent for the first 2 years, and would we land a sole charge position on graduation. Employment overseas was easily obtainable; NZ Physiotherapy enjoyed a strong reputation. The recent economic recession world-wide, closure of many hospital positions, restrictive financing for individuals requiring physiotherapy, and changing standards internationally, have made procuring positions much more difficult for today's graduate. However, I also suspect that today's graduates, better educated, are more versatile and better equipped to maximize opportunities. They also have the capacity to demonstrate that physiotherapy not only can be effective but also cost-effective.

Finally, may I challenge current practitioners to ensure that the profession addresses the full scope of health problems, in particular the sadly neglected areas of chronic and secondary disabilities, as well as the looming problem of the seniors' explosion. Dementia now predicted to affect over 65 million people within a few decades. I am concerned about the prevalent interest in treating healthy individuals with a high potential to return to their former level of activity. When I graduated the needs of patients with poliomyelitis dominated health care. Today and tomorrow it is the need of the ageing population to retain their independence, and the needs of individuals with cerebral palsy, muscular dystrophy and cystic fibrosis, to name a few, whose lives have been extended for several decades by modern health care.

Clinicians need to be as effective as possible in the least amount of time as possible. More is not necessarily better. Pursue specialization but not at the expense of always considering the client as a whole. Current knowledge of neurophysiology, motor and cognitive learning, is I believe as important to musculoskeletal specialists as knowledge of muscles, joints and kinesiology is to the neurology specialist, to give a few examples. Other health care professions have adopted a more administrative role but I believe that our profession, physical therapy is, at its heart, a hands-on, caring profession and should never lose sight of that core. Numerous other disciplines and professions are reaching out for a 'piece of the rehabilitation pie' and if physical therapy is to be *first among many,* not just *one of the many* (Walker 2002), our practice must be holistic and with a scientific basis.

For the clinician of today and tomorrow, first access, autonomous practice, and physical therapy diagnoses carry an awesome responsibility and a greater potential of legal issues. A critically thinking and constantly evaluating clinician will better overcome these hurdles.

Joan M Walker
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REFERENCES

Copeland J (2012) Should cervical manipulation be banned? *Physio Matters* July:10.

Helewa A and Walker JM (2000) Critical Evaluation of Research in Physical Rehabilitation: Towards an Evidence-based Approach. WB Saunders, Philadelphia.

Jette A (2012) Face into the Storm, 43rd McMillan Lecture. *Physical Therapy* 92(9): 1221-1229.

Walker JM (2002) Will Physiotherapy be first among many, or will it simply be one of the many? Enid Graham Memorial Lecture Award. *Physiotherapy Canada*, 54(4):226-232.

HAND MADE HISTORY

Electromagnetic therapy: fact or fiction

Hugh U. Cameron, MBChB, FRCS[C]

Electrotherapy and electromagnetism

Electrotherapy and electromagnetism have recently been reintroduced into medicine, principally in the field of locomotor systems. Extravagant claims have been made and the various techniques in use have been disputed vehemently. Is this another example of the 'Emperor's clothes' phenomenon or is there somewhere a germ of truth?

Historical

Four hundred and fifty years ago Theophrastus Bombastus Paracelsus von Honenheim reported on the use of magnetic iron rodlets which, when adequately placed, 'Heal fractures and ruptures, pull hepatitis out and draw back dropsy, also healing fistulae, cancer, and blood flows of women'. Naturally, such claims did not endear Paracelsus to the medical establishment of the day, and his observations were not investigated again until Franz Anton Mesmer,a qualified physician, began to study magnetism in the 18th century. He achieved cures with his iron rod magnets, but unfortunately, later moved on to the transmission of 'magnetic forces' by the laying on of hands.

In the course of the 18th century, basic studies on electricity were carried out by Franklin, Lavoisier, Galvani and Volta. Some of these studies are still done by every medical student today. At the end of the 18th century, Michael Faraday discovered electromagnetic induction, and based on his work, inventors in England developed in 1869 a device into which the patient was placed. The device produced magnetic waves which flowed lengthwise through the patient. Outside of Eastern Europe, such devices were regarded as the implements of quacks and charlatans.

Electromagnetism began its long trek back to orthodox medicine with a classic experiment of Fukada and Yasuda[1] which demonstrated the piezo-electric property of bone. Piezo electricity is a property of anisotropic crystalline structures and consists of elastic and electric oscillations in reversible causality. Elastic and electrical polarisation has a linear dependence; both can be produced not only though mechanical forces, but also through the forces of an electric field. This gave the first rational explanation of Wolff's law that in bone, function determines form.

This led to considerable investigative activity and it was shown that constant direct current in the microampere range when applied to bone will cause new bone formation mostly around the cathode or negative electrode.[2] It was then shown that both pulsed direct current, and alternating current produced bone formation at both electrode sites. These effects can be produced either invasively, i.e. by implanting an electrode, or non-invasively by inducing electrical potentials by means of electric fields, or pulsed magnetic fields in close proximity to tissues. The hazards associated with high voltage electric fields made it less attractive than pulsed magnetic fields for clinical

Cameron HU (1983). Electromagnetic therapy: fact or fiction. New Zealand Journal of Physiotherapy 11(2):31-32.

use. Magnetic fields, when pulsed in close proximity to tissues will induce a current, the direction of which will alternate as the magnetic flux rises and collapses.

Current state of the art regarding bone healing

Several systems are currently available for clinical use. These are used when a fracture fails to unite or to obtain fusion in difficult cases.

Non- invasive

The two commonly used non-invasive systems are the EBI system developed by Bassett[3] and the DeHaas system.[4] The EBI system is calibrated for each patient and uses very low intensity magnetic fields with a very rapid pulse. This device has been widely marketed and does appear to have an 80 to 85% success rate in achieving union. The DeHaas system, developed in Calgary, uses a high field strength of 200 gauss pulsed at 1 Hz. The success rate for this device is similar to that of Bassett's. These systems can be used in the patient's home and are generally used for 20 hours/day for six to 12 weeks, which means that during this time the patient is relatively immobile. A cast or splint is used to protect the bone and support the magnet.

Invasive

A totally implantable system was developed by Alan Dwyer of Australia in early 1971 to promote posterior spine fusion. His work was expanded by Sir Dennis Paterson to provide electrical stimulation for the treatment of non-unions, delayed unions congenital pseudo-arthrosis and bone defects. This method also has an 80 to 85% success rate and is useful in that no patient compliance is required. This system can be used in places where it would be impossible to apply a magnet externally. It is possible to use this in conjunction with plates and screws. The disadvantage is that an operation, with its attendant risks, is necessary, and at the end of treatment, usually six months, the implant has to be removed. Naturally, in such a system, problems do appear given the relatively short shelf-life of six months and the rather fragile cables. Improvements in this system are overdue and hopefully will soon be available.

A system exists in which percutaneous electrodes are used with an external power source, but this would seem to have the disadvantages of both of the other systems demanding both operative insertion and patient compliance.

Other applications

Devices, similar to that developed by Smith in 1869 are currently being marketed and supposedly effect dramatic cures in a range of illnesses. These claims are so fantastic as to invite disbelief. One such unit* was tested at the Orthopaedic and Arthritic Hospital in Toronto, to determine if it could reduce postoperative swelling in total knee replacement. Surprisingly, the pulsed magnetic fields were found to reduce swelling significantly. However, no other parameter was tested.[6]

Workers with the DeHaas system have demonstrated improved tendon and ligament healing in experimental animals, and there is some suggestion that pulsed magnetic fields may have a role to play in the treatment of osteoporosis.

*Magnetopulse®-Elec Canada

The Bassett and DeHaas systems have been tried in osteomyelitis. In infected non-unions, as the bone heals it has been found that the infection subsides. In a few cases, the author has tried these units in cases of chronic osteomyelitis. While the systems were in place, the sinuses tended to heal, but most recurred with cessation of treatment. In the laboratory, electromagnetic stimulation appears to have no effect whatsoever on bacterial growth.

Mode of action

The fundamental cellular mechanism of action is unclear. Various observations have been made; i.e. it has been shown that electromagnetic stimulation alters the hydroxyproline/hydroxylysine of healing tendons. An increase in collagen formation and proteogly synthesis has been demonstrated in experimental osteoporosis. In established non-unions, the tissues in the gap between the bones appear to calcify progressively and then to be invaded by blood vessels coming from the bone margins; there is progressive replacement of calcified cartilage by woven and lamellar bone.

Clinical use

At present, clinical use of these techniques is restricted to delayed union and non-union of fractures. The speed of healing in a normal fracture is not influenced by electromagnetic stimulation. The techniques do not work in synovial pseudo arthrosis or in the presence of uncontrollable movement. Interposed soft tissue and a radiographic gap of more than 1em may prevent union. The presence of any of these factors necessitates surgical intervention with bone grafting and, if necessary, with internal fixation.

Infected non-union should be handled in the normal way with thorough debridement, either closed suction irrigation or wide saucerisation, bone wafting and then stimulation. Infection is probably a contraindication to the use of a fully implantable stimulator.

Avascular necrosis of bone is a relative contraindication and bone transplantation using microvascular techniques is preferable under these circumstances.

While not clinically proven, suspicion exists that pulsed magnetic fields help in the healing of chronic ulcers and perhaps even help in the return of sensation and pseudomotor function in chronically insensate skin such as that following degloving injuries.

Conclusions

Much basic work is required to be done in this field of electromagnetic stimulation, but a very powerful tool has been added to the treatment of extremely difficult problems.

REFERENCES

1. Fukada E, Yasuda I Piezoelectric effects in collagen. Japn J Appl Phys 1964;3:117-21.
2. Friedenberg ZB, Kohanim J The effect of direct current on bone. Surg Gynecol Obstet 1968; 127:97-102.
3. Basset CAL, Mitchell SA, Gaston SA Treatment of ununited tibial diaphyseal fractures with pulsing electromagnetic fields. J Bone J Surg 1981; 63A:511-23.

4. DeHaas WG, Lazaroviv MA, Morrison DM The effect of low frequency magnetic fields on the healing of esteotomized rabbit radius. Clin Orthop 1979;145:245-53.

6. Paterson D, Lewis GN, Cass CA Clinical experience in Australia with an Implanted bone growth stimulator. Orthop Trans 1979; 3:288-9.

6. Cameron HU, Mode M, Thorthon S The effect of pulsed magnetic fields in the reduction of post-operative edema. (In preparation).

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Commentary

Almost 30 years has passed since Cameron wrote this article on the use of electromagnetism to aid bone healing. The second paragraph describes the historical development of such an approach with the final sentence delivering a startling message of the times in 1869; "*outside of eastern Europe, such devices were regarded as the implements of quacks and charlatans*". What view does the physiotherapy profession hold in New Zealand in 2012?

In the early 1950s, work was published on the piezoelectric forces within bone (Yasuda 1953), and consequently this led to scientists exploring the manipulation of electromagnetic fields (EMF) to enhance the healing process. Since then numerous studies have been published reporting on the effects. However, a recent Cochrane review concerning the use of EMF to stimulate bone healing (Griffin et al 2011) found only 4 RCTs published between the years 1984-2003 that met their inclusion criteria. Not unexpectedly they concluded that although the meta-analysis favoured EMF stimulation, it was not statistically significant and the lack of evidence precluded any recommendation for use in clinical practice. The United States Food and Drug Administration have approved the use of pulsed EMF for the treatment of musculoskeletal disorders such as non-union of fractures (Bassett et al 1978; Heckman et al 1981), congenital pseudoarthroses (Bassett et al 1991), RA (Ganguly et al 1998), OA (Nelson et al 2012) and tendinopathy (Binder et al 1984). In order to receive such approval manufacturers of these devices must show through scientific evidence that the device is effective and safe.

Research suggests that the mechanism of action of pulsed EMF is the induction of ionic currents within the tissues which in turn stimulate changes in cellular calcium and cyclic adenosine monophosphate levels (Thumm et al 1999), along with increased synthesis of collagen, proteoglycans, DNA and RNA (Pezzeti et al 1999; Goodman et al 1989). Pulsed EMF has also been shown to increase levels of reactive oxygen species and nitric oxide production (Kim et al 2002); all essential for the healing and remodeling of damaged tissue. So, when the direct effects are measureable, as in cellular and animal studies, it is very difficult to dispute that EMFs have an effect on the healing process. When it comes to clinical trials where the outcome measures are mostly indirect measures of effects, the evidence turns out to be not as robust and strong. This is due to a number of confounding factors such as application technique, treatment regime, dose/response relationships etc; resulting in some trials reporting positive effects and others reporting no effect.

In today's healthcare climate one of the most widely accepted definitions of EBM is "*the explicit, judicious, and conscientious use of current best evidence from health care research in decisions about the care of individuals and populations*" (Sackett et al 2000). This definition puts meta-analysis and RCTs above opinion of the expert, who uses knowledge from a variety of sources, including knowledge of pathophysiological mechanisms, and knowledge derived from clinical experience, to inform decisions. The evolution of EBM has seen a softening of strict adherence to "evidence from research is the best evidence", to include clinicians' experiential evidence, and the patient's goals and values. Therefore, the above definition of EBM has more recently been modified to; "*the integration of individual clinical expertise and patient preferences with the best available external clinical evidence from systematic research and consideration of available resources*" (Tonelli 2006).

Considering the more recent definition of EBM, and the improvement in the dissemination of research knowledge and knowledge in general, what is your view on pulsed EMF for the treatment of musculoskeletal disorders? Is it different from the popular view of 1869?

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REFERENCES

Bassett CA, Mitchell SN, et al (1978) Repair of non- unions by pulsing electromagnetic fields. *Acta Orthopaedica Belgica* 44(5):706–24.

Bassett CA, Schink-Ascani M (1991) Long-term pulsed electro- magnetic field (PEMF) results in congenital pseudarthrosis. *Calcif Tissue Int* 49:216–220.

Binder A, Parr G, et al (1984) Pulsed electromagnetic field therapy of persistent rotator cuff tendonitis. A double- blind controlled assessment. *Lancet* 1:695–698.

Ganguly KS, Sarkar AK, et al (1998) A study of the effects of pulsed electromagnetic field therapy with respect to serological grouping in rheumatoid arthritis. *J Indian Med Assoc* 96:272–275.

Goodman R, Wei LX, et al (1989) Exposure of human cells to low-frequency electromagnetic fields results in quantitative changes in transcripts. *Biochim Biophys Acta* 1009: 216–220.

Griffin XL, Costa ML, et al (2011) Electromagnetic field stimulation for treating delayed union or non- union of long bone fractures in adults. *Cochrane Database of Systematic Reviews*, Issue 4. Art. No.: CD008471. DOI: 10.1002/14651858.CD008471.pub2.

Heckman JD, Ingram AJ, et al (1981) Nonunion treatment with pulsed electromagnetic fields. *Clin Orthop Relat Res* 161:58–66.

Kim SS, Shin HJ, et al (2002) Enhanced expression of neuronal nitric oxide synthase and phospholipase C-g1 in regenerating murine neuronal cells by pulsed electromagnetic field. *Exp Mol Med* 34:53–59.

Nelson FR, Zvirbulis R, et al (2012) Non-invasive electromagnetic field therapy produces rapid and substantial pain reduction in early knee osteoarthritis: a randomized double-blind pilot study. *Rheumatol Int* DOI 10.1007/s00296-012-2366-8

Pezzeti F, De-Mattei M, et al (1999) Effects of pulsed electromagnetic fields on human chondrocytes: an in vitro study. *Calcif Tissue Int* 65:396–401.

Sackett DL, Straus S, et al (2000) Evidence-Based Medicine: How to Practice and Teach E.B.M. London, Churchill Livingstone.

Thumm S, Loschinger M, et al (1999) Induction of cAMP- dependent protein kinase A activity in human skin fibroblasts and rat osteoblasts by extremely low-frequency electro- magnetic fields. *Radiat Environ Biophys* 38:195–199.

Tonelli MR. (2006) Integrating evidence into clinical practice: an alternate to evidence based approaches. *Journal of Evaluation in Clinical Practic*e 12(3), 248-256.

Yasuda I. (1953) Fundamental aspects of fracture treatment. *Journal of the Kyoto Medical Society* 4:395-406.

The three-way health partnership between the Accident Compensation Corporation (ACC), the musculoskeletal physiotherapist and the client analysed through critical theory and postmodern lenses

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ABSTRACT

The purpose of this paper is to employ critical theory and postmodern world views to investigate and critique aspects of physiotherapy practice. The paper initially focuses on the power balance within the three-way health partnership between the Accident Compensation Corporation (ACC), the musculoskeletal physiotherapist and the client. Next, it addresses the concepts of knowledge and truth within practice and identifies the epistemological hierarchy that exists between discourses. The paper finds that stakeholders in health care are stratified in a hierarchical system dominated by an established order. However, although tiered, all stakeholders are co-dependently linked and rely on one another to achieve health-related goals. Furthermore, as well as oppressing, power is used positively to educate members of society regarding good health practices. Currently, medical models are driven by a scientific epistemology, crowning evidence-based practice (EBP) as the gold standard approach to healthcare. But, conversely, physiotherapy's large subjective component cannot be overlooked. Ultimately, physiotherapists need to recognize the dominance of EBP and learn to shape knowledge from a wide variety of sources above and beyond statistically significant health science.

Maclachlan L (2012) The three-way health partnership between the Accident Compensation Corporation (ACC), the musculoskeletal physiotherapist and the client analysed through critical theory and postmodern lenses. New Zealand Journal of Physiotherapy 40 (3): 113-116.

Key words: Postmodernism, Critical Theory, Physiotherapy

INTRODUCTION

As a physiotherapist, my job is to help rehabilitate the physical problems that my clients present with. However, treating physical problems requires a lot more than a physical approach (Foster and Sayers 2012, Lindquist et al 2006). To succeed in this endeavour, I must enter into a three-way health partnership with the client, and with the Accident Compensation Corporation (ACC), the funding body that 'provides comprehensive, no-fault personal injury cover for all New Zealand residents and visitors to New Zealand' (ACC 2012) and, thus, subsidizes injury-related physiotherapy services. Each partner brings to the health partnership unique offerings and plays a significant role in aiming to achieve a high standard of client-centered care.

As well as providing therapy, as a physiotherapist, I must act as a spokesperson and present to ACC on behalf of the client. This occurs whenever any ambiguity exists surrounding the client's initial injury claim or when, as often happens, a client needs further treatment above and beyond what has already been allocated. As treatment progresses and the partnership evolves, all three members adopt a role and engage in a complex political, economic and cultural production involving power-plays, dominance, morality and truth.

In a Utopian world, this partnership would be efficient, fair and just. Each member would behave accordingly and all would come from the interaction feeling well-treated, valued and respected. However, thanks to a catalogue of societal structures, inter-subjective factors and the unpredictability of human nature, this is not always the case. If corrective steps are to be taken here, these phenomena need to be analyzed and addressed.

Critical theory is a social theory that aims to understand critique and change society by liberating those who are enslaved by social circumstances through the hegemonic operation of power (Stanford Encyclopedia of Philosophy 2008). Thus, in an attempt to develop theoretical explanations regarding this three-way health partnership, I shall examine the actions and societal roles of ACC, the physiotherapist (me) and the client through a critical lens.

Next, I will explore the groundings of the resources that help guide my physiotherapeutic practice. In doing so I will investigate the concept of different world views as 'narratives' and how their hierarchical arrangements dictate what is accepted as 'knowledge' and 'truth'. My intention here will be to support the postmodern viewpoint that any one perspective of the world can only ever be a fragmented part of a larger reality (Loughlin 2008). I will also demonstrate how subjectivity and opinion manifest themselves in health science objectivity; questioning validity claims and current gold standards.

Critical Theory

Critical theory provides both descriptive and normative platforms for social inquiry, with the intent of decreasing domination and increasing freedom across society (Stanford Encyclopedia of Philosophy 2008). According to Duchscher and Myrick (2008), proponents of critical theory argue that an awareness of oppressive social structures is inseparable from the pursuit of emancipatory social action. Therefore, if physiotherapy as a field of practice aspires to contribute to greater social equality, its stakeholders must view it through this philosophical lens; thus analysing how care is delivered and how vested interests and power balances within the system affect the ultimate outcomes.

When the client presents for physiotherapy the aforementioned partnership begins. From the outset, with a variance in ways of acting (habitus), all the stake-holders mentioned above enter into a social space or health field where, according to Bourdieu (1998) they are distributed according to economic and cultural principles of differentiation. As the governing body, it is easy to assume that ACC dominates this field. However, the inter-relationships and co-dependencies between the aforementioned parties are complex.

With no physiotherapeutic knowledge and in need of help, the client is instantly dependent on the physiotherapist. But instead of liberating the client from the oppressive structures that characterize, normalize and perpetuate unequal relationships (Duchscher and Myrick 2008), it could be argued that I, as the physiotherapist, augment domination through concrete cultural forms, such as technical language, that, as Giroux (1985) states actively silence people.

There are obvious financial interests for me as the physiotherapist regarding my relationship with the client but Foster and Sawyers (2012) uncover the caring and emotional aspects that also drive the bond. These complex and contradictory emotions that are integral to physiotherapy (Foster and Sawyers 2012) demonstrate some of the positive aspects of power. Foucault (1980) discusses how, in this type of situation, through education, power productively traverses to produce knowledge and discourse.

However, as education is often a representation of the dominant culture (Giroux 1985), it could be argued that the physiotherapist is abstracting from complex and problematic social structures. This, Waitzkin (1989) states, reduces the effective critique of such structures; the nullification of the patient's social complaints. For instance, relieving back pain someone has acquired from continuous lifting in a poorly paid manual job remedies the painful symptoms, but not the labour-related cause.

As the physiotherapist, I also act as a bridge between the client and ACC. Bourdieu (1998) has labelled agents in this immediate location, between polar extremes as the 'petit-Bourgeoise'. ACC, as the funding body provide structure. But, although potentially productive, imposed structures often limit progress through prescribed behaviours (Duchscher and Myrick 2008). The funding regimes that enforce structure also act as a source of tension and detract from the physiotherapist's primary focus; i.e. serving the client (Foster and Sawyers 2012).

Part of ACC's structure includes administration, a process I undertake on behalf of the client. However, the client, without the correct technical vocabulary, according to Barry (2002), remains isolated in this interaction and relies fully on my communicative action and validity claims. Here I am in a powerful position, as an influential person, able to use persuasive mechanisms in reaching an understanding at a higher level (Habermas 1989). Such practices, in turn, create what Foucault (1980) calls a 'medico-administrative knowledge' which further disempowers the client and can be viewed as a hegemonic practice.

A greater understanding of the power balance between ACC and myself, as a physiotherapist, can be gained by returning to Bourdieu's (1998) concepts of habitus (social structure) and field (a social arena). Habitus, described by Bourdieu (1998), includes principles of vision and a unity of style and practices. There is, therefore, an overlapping between the parties. Both ultimately want to rehabilitate injuries acquired through accidental damage and maintain a healthy population.

But, as a physiotherapist, the methodologies and processes I use to achieve the uniting vision often vary dramatically from ACC's praxis. Without emotional ties to the client, ACC are more likely to be concerned with the financial implications of ongoing treatment, be ideologically driven by the notion that a healthy person produces economically (Waitzkin 1989) and focus on the immediate physicality of a problem. In contrast, as discovered by Foster and Sawyers (2012), emotional connections often draw the physiotherapist to continue with the client, even after the physical treatment goals have been achieved.

The possession of capital is another area of conflict. Using Bourdieu's model of field, Mooney et al (2008) identify the different types of capital owned by the physiotherapist and other agents – in this case ACC – and how these weighted possessions give rise to tension. With the ability to grant or deny treatment, ACC are the established order and have what Bourdieu (1998) terms economic capital. Conversely, as the physiotherapist, with clinical knowledge, I am viewed as a healthcare authority and thus possess cultural capital.

This creates a strange symbiosis, where both need one another to help rehabilitate the client. But differing praxis and capital values (cost efficiency for ACC and holistic care for the physiotherapist) can damage the relationship. Then there is the client, bereft of both cultural and economic capital in this context and, thus, dependent on the physiotherapist. According to Mooney et al (2008), this separation or 'distinction' between ACC and the client further perpetuates levels of tension.

Initially the client can apply to ACC for treatment by filling in a treatment request form (ACC45). This requires no technical knowledge or healthcare acumen, but only grants the client with a limited number of consultations. If the client's problems have not resolved within the 'trigger' number, I must apply for a treatment extension by filling in a request for further treatment form (ACC32). In this instance the client relies on my ability as a speaker to influence the addressee (ACC). Habermas (1989) suggests this is done by persuasive power manifested in 'communicative achievement of consensus' and an acceptance that rationality and knowledge are linked (Habermas 1984).

Ultimately the client must assume the role of actor here, forsake lifeworld contexts and adopt formally organized domains of action (Habermas 1989). With ideological power deemed greater than material power (Barry 2002), the onus is then on me, as the physiotherapist to express cultural capital by requesting further treatment. As well as earning further care for the client, the form can also be viewed as a critical tool that interrogates power and challenges the dominant definitions of knowledge (Giroux 1985). From here though, in judging the legitimacy and validity of further treatment claims, a key question is, how do ACC rule on what constitutes a truth?

POSTMODERNISM

Postmodernism recognises that knowledge is constituted by power and its interests (Fox 1991). It also recognises the competition between discourses; the epistemological frameworks wherein specific cultural attitudes are expressed and practised (Dybicz 2011). In medical and healthcare realms, (Loughlin 2008) highlights that a hierarchy of discourses exists dominated by scientific evidence, in the form of randomised controlled trials (RCT). But the personal and subjective nature of healthcare and, in particular, physiotherapy demands a critique of this dominance.

When assessing human behaviour, (Goding and Edwards 2002) pertinently point out that a scientific, positivist criterion of validity and generalisability is wholly inadequate; failing to factor in societal complexities and a chaotic lifeworld. What is more, when decision-making, as a physiotherapist, I must take into account many non-scientific factors such as patient goals, contexts and perspectives, views of colleagues and different forms of published research; the subjective variables that impact on the merits of evidence (Loughlin 2008).

Ultimately, though, I have to make a diagnosis for the benefit of everyone involved; the client so they can develop coping strategies and learn about the problem, and ACC so they can assess the claim, provide funding and collect statistics. When applying to ACC on behalf of the patient for ongoing treatment, I must provide evidence to 'validate ongoing treatment'. But what exactly constitutes evidence and can evidence ever be labeled as the truth?

In expressing assessment findings, I provide an interpretation of a condition. But according to (Habermas 1984) an interpreter understands only certain assertions, values and norms and, therefore, constructs a personal understanding of a context. With the feeding of intellectual, moral and aesthetic judgments into explanatory structures (Fox 1991), it could also be argued that a subjective component to any diagnosis I produce is unavoidable. Furthermore, considering medical or scientific knowledge announces itself in the form of a narrative (Lyotard 1994), it is easy to see how bias in the form of my subjectivity can infiltrate theoretical structures. Even the most stringent empiricists and evidence-based practitioners would, thus, struggle to deny that all professional judgments lack complete objectivity and are merely educated 'opinions' (Loughlin 2008).

Accepting the errors of modernity and recognising the mistakes of deriving ideal objectivity from a decentred world (Habermas 1984), encourage me to follow discourse dialectic and ask philosophical questions. Regarding practice, is it possible to combine high quality scientific evidence with inter-subjectivity and personal beliefs when planning rehabilitation programmes?

Although the gold standard status of evidence-based practice (EBP) devalues other epistemic currencies (Loughlin 2008), the findings of well conducted treatment studies arm me with treatment options and are still integral to physiotherapy. As demonstrated above, scientists and the conductors of research may be no more logical or objective than others, but Rorty (1999) commends, with praise, the institutions they have developed and proposes them as 'models for the rest of culture'.

But, alongside this scientific knowledge bank and EBP, there stands my physiotherapeutic intuition. I have to understand that the client can only refer to a personal, subjective world, thus, I must accept a lifeworld bounded by the totality of interpretation (Habermas 1984). Considering this human complexity in an ever-changing environment, I may only be able to view quantitative research as statistically significant but clinically superficial (Goding and Edwards 2002) and in need of support from health professional interactions, interpersonal skills and intuitive judgments.

In considering these points, it would seem that, as a physiotherapist, I can happily unite medical science and narrative discourse to successfully practise. But there still remains a theoretical incommensurability (Okasha 2002) and (Lyotard's 1994) claim that the validity of narrative knowledge cannot be judged on the basis of scientific knowledge and vice versa. To me, this seems the ultimate parody considering science relies on narratology to make known its findings, and philosophy to question the assumptions that scientists take for granted (Okasha 2002).

Placed between the client and ACC, I am faced with a political dilemma. Incorporate all the elements of the client's story to biopsychosocially diagnose what I believe to be the client's problem and risk not meeting ACC injury criteria; or pigeon-hole a condition to fit ACC's limited diagnostic tags and risk limiting my scope of practice. In this dilemma, I have to accept that even though a physiotherapist attempts to break down psychological and physical barriers (Foster and Sayers 2012), I may lack the education, understanding and the experience to do so. Conversely, it can only be assumed that ACC play down the uncomfortable supposition that neatly fitting, whole stories suppress information to sustain an appearance of unity (Fox 1991). Ultimately, it is important that both parties recognise that serious flaws are made in practice when objectivity and rationality are considered to be antithetical alternatives to thinking that is subjective and personal (Loughlin 2008).

In granting treatment, ACC consider my diagnostic claims and evaluate the professional and theoretical knowledge within. To do this, the organisation uses guidelines, but (Loughlin 2008) exposes the embarrassing fact that such guidelines are increasingly produced by those removed from the work contexts they regulate. None the less, to control budgets, care has to be standardised and ACC will make decisions based on my clinical 'rationality'. As (Habermas 1989) points to, knowledge is embodied in normatively regulated action, thus a physiotherapist will be considered rational by producing a strong argument with reference to existing normative contexts.

Although subject-laden, by using professional technology and strategies, the physiotherapist produces what (Habermas 1989) terms objectivicated knowledge. Again, we return to the fact that expression or, in this case, writing as a method of 'knowing' nurtures a researcher's voice and allows the unknown into healthcare (Corroto 2011).

CONCLUSION

My aim, in this paper, has been to gain a better understanding of, and critique the three-way health partnership between ACC, the musculoskeletal physiotherapist and the client. To achieve this goal I have used critical theorist models and a postmodernist questioning of truth. In the process I have shown that stakeholders and groups in health care are stratified; tiered in a hierarchical system that is dominated by a power-yielding, established order and regulated according to the ownership of capital, whether it be political, economic or cultural.

A critical approach has also helped me demonstrate that power, as well as constraining and oppressing, can be used positively to educate members of society regarding their health. Furthermore, even though healthcare is manipulated by dominant powers, all stake-holders are all co-dependently linked and rely on the others to achieve health related goals.

The current medical model, implicit by the use of simple physical diagnoses, continues to be driven by a scientific epistemology. However, while physiotherapy demands an evidence-based underpinning, the profession must not devalue subjectivity, intuition and qualitative research as sources of knowledge for the clinician. With the help of a postmodern approach, I have also shown that medical science requires subjective actions such as interpretation and reporting to make known its findings.

It can be said that incommensurability exists between scientific and normative discourses (Okasha 2002). However, for physiotherapists, it is of paramount importance that they learn, from postmodernism, the importance of shaping knowledge from a wide variety of sound sources and not solely relying on statistically significant health science.

In understanding, critiquing and improving physiotherapy, critical theory and postmodernism analytically stand shoulder to shoulder. They both commonly believe that sociological analysis is required to grapple with the value laden character of knowledge (Fox 1991, Lyotard 1994). Sadly though, in writing this essay, I have discovered that physiotherapy has so far under-utilized critical theory and postmodernism as tools for critique and improvement of the profession.

Ultimately, for physiotherapy to recognize its full potential, it must learn to embrace the subjective variables that impact on client management while still recognizing the strength of randomised controlled trials and quantitative research. To recognize my full potential as a physiotherapist, I must not take the structure of the health system I practice within for granted. I must learn to critique the practices that disempower and isolate people and question the sources and value of knowledge and truth.

KEYPOINTS

- Stakeholders in healthcare are stratified in a hierarchical system which is dominated by a powerful established order.
- All stakeholders possess capital (economic, political and cultural) and are, therefore, co-dependently linked in achieving health-related goals.
- Medical models are driven by a scientific epistemology that is statistically significant but often fails to account for the inter-subjective, chaotic nature of life.
- Physiotherapists need to recognize the subjective component of their practice and learn to combine professional intuition and other knowledge sources along with scientific evidence to practise successfully.

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REFERENCES

Accident Compensation Corporation (2012) Homepage. http://www.acc.co.nz (Accessed July 27 2012).

Barry P (2002) Beginning Theory: An Introduction to literary and cultural theory. Manchester: Manchester University Press.

Bourdieu P (1998) Practical Reason: On the Theory of Action. Cambridge: Polity Press.

Corroto C (2011) A Postmodern Headache. *Qualitative Enquiry* 17 (9): 854-863.

Duchscher JD and Myrick F (2008) The Prevailing Winds of Oppression: Understanding the new graduate experience in acute care. *Nursing Forum* 43 (4): 191-206.

Dybicz P (2011) Anything goes? Science and social constructions in competing discourses. *Journal of Sociology & Social Welfare* XXXVIII (3): 101-122.

Foster C and Sawyers J (2012) Exploring physiotherapists' emotion work in private practice. *New Zealand Journal of Physiotherapy* 40 (1): 17 - 23.

Foucault M (1980). Power/Knowledge. Hertfordshire: Harvester Wheatsheaf.

Fox NJ (1991) Postmodernism, rationality and the evaluation of Healthcare. *Sociological Review* 39(4): 709-744.

Goding L and Edwards K (2002). Evidence-based practice. *Nurse Researcher* 9 (4): 45-57.

Giroux HA (1985) Introduction. In Freire, P. The politics of education. New York: Bergin and Garvey.

Habermas J (1984) The theory of communicative action. Volume one: Reason and the rationalization of society. Boston: Beacon Press.

Habermas J (1989) The theory of communicative action. Volume two: Lifeworld and system: A critique of functionalist reason. Boston: Beacon Press.

Lindquist I, Engardt M, Garnham L, Poland F and Richardson B (2006) Physiotherapy students' professional identity on the edge of working life. *Medical Teacher* 28 (3): 270-276.

Loughlin M (2008) Reason, reality and objectivity – shared dogmas and distortions in the way both 'scientistic' and 'postmodern' commentators frame the EBM debate. *Journal of evaluation in clinical practice* 14: 665-671.

Lyotard JF (1994) The postmodern condition: A report on knowledge. Manchester: Manchester University Press.

Mooney S, Smythe L and Jones M (2008) The tensions of the modern-day clinical educator in physiotherapy: a scholarly review through a critical theory lens. *New Zealand Journal of Physiotherapy* 36 (2): 59-66.

Okasha S (2002) Philosophy of Science: A very short introduction. Oxford: Oxford University Press.

Rorty R (1999) Objectivity, Relativism and Truth. Cambridge: Cambridge University Press.

Stanford Encyclopedia of Philosophy (2008) http://plato.standford.edu/entries/critical-theory/ (Accessed April 20 2012).

Waitzkin H (1989) A critical theory of medical discourse: Ideology, social, control, and the processing of social context in medical encounters. *Journal of Health and Social Behaviour* 30: 220-239.

Nordic walking versus ordinary walking for people with Parkinson's disease: a single case design

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ABSTRACT

This single case repeated measures mixed methods design tested the feasibility of protocols for a larger investigation of the effect of Nordic and ordinary walking on physical function and wellbeing in people with Parkinson's disease. There were five six week phases (ABACA); A = baseline/washout, B = ordinary walking, C = Nordic walking. A 64 year old female with an 11 year history of Parkinson's disease participated. Physical function was measured weekly with the six-minute walk test, Timed Up and Go test, and 10-metre walk test. The mobility and activities of daily living subscales of the Parkinson's Disease Questionnaire were answered at the beginning of the study and end of each phase. At the end of the study the participant was interviewed about her experiences of the walking and the physical and psychological effects. Repeated measures analysis of variance analysed the statistical physical function data and the transcribed interview data were analysed using content analysis. No significant results occurred in the expected direction for the physical function analyses. Interview analysis revealed the participant considered Nordic walking more beneficial than ordinary walking; her general health improved, and she coped better with daily activities. Future similar research should include objective measures of daily functional activities and aerobic fitness.

Bassett S, Stewart J, Giddings L (2012) Nordic walking versus ordinary walking for people with Parkinson's disease: a single case design. New Zealand Journal of Physiotherapy 40(3): 117-122.

Key words: Single case design, mixed methods, Nordic Walking, Parkinson's disease, physical function

INTRODUCTION

Nordic walking is an increasingly popular activity undertaken by people with Parkinson's disease. It involves walking with two poles using a reciprocal arm leg action, and is reputed to improve aerobic fitness, body strength, mobility, and coordination (van Eijkeren et al 2008). Thus far the findings of the small body of Nordic walking research show it improves physical function in people who have mild to moderate Parkinson's disease (Reuter et al 2006, van Eijkeren et al 2008).

Baatile et al (2000) and van Eijkeren et al (2008) used single group designs to examine the effects of Nordic walking on people with Parkinson's disease. Baatile et al (2000) found that by the end of an eight week course of Nordic walking participants had significantly better function ($p < 0.03$) as measured by the Parkinson's Disease Questionnaire-39 item (PDQ-39) and the Unified Parkinson's Disease Rating Scale (UPDRS). Anecdotally participants reported feeling stronger, and being able to undertake daily activities with greater ease. van Eijkeren et al (2008) had similar findings with the participants having significantly better physical function ($p < 0.01$) on the PDQ-39, the Timed Up and Go test (TUG), 10 metre walk test (10MWT) and the six minute walk test (6MWT) at the end of the Nordic walking. While both studies used reliable and valid measures of function for people with Parkinson's disease they lacked a control group and had small sample sizes of six and 19, respectively (Baatile et al 2000, van Eijkeren et al 2008).

The other two Nordic walking studies were prospective trials with comparison groups (Ebersbach et al 2010, Reuter et al 2006). Ebersbach et al (2010) randomly allocated participants to one of three groups; eight week Nordic walking programme, four week LSVT®BIG exercise programme (comprising whole body high amplitude movements), or a home programme of stretching and endurance exercises. At the end of the study the LSVT®BIG group scored significantly better ($p < 0.05$) than the other two groups on the motor performance sub-scale of the UPDRS and the TUG, but did not differ significantly on the 10MWT and the PDQ-39 scores. Reuter et al (2006) compared 12 weeks of relaxation exercises and Nordic walking, with only the latter group being significantly faster ($p < 0.05$) on the 12MWT and treadmill test, and having increased step length and step frequency. These studies' main strengths were the inclusion of comparison groups, and their large sample sizes 60 (Ebersbach et al 2010) and 68 (Reuter et al 2006). A limitation of all the Nordic walking studies of people with Parkinson's disease (Baatile et al 2000, Ebersbach et al 2010, Reuter et al 2006, van Eijkeren et al 2008) is that there was no comparison with ordinary walking.

Comparisons of Nordic walking with ordinary walking in other areas of health research have found significant improvements in physical fitness following both forms of walking in middle-aged women (Kukkonen-Harjula et al 2007) and men following acute coronary syndrome (Kocur et al 2009). In light of these findings the next step in the research of Nordic walking for people with Parkinson's disease would be to compare it with ordinary walking. It would also be useful to explore these peoples' personal experiences of the two forms of walking and the effects on physical and psychological wellbeing.

Therefore, the purpose of this single case mixed methods, repeated measures study was to pilot the protocols in preparation for a larger investigation into Nordic walking for people with Parkinson's disease. We predicted that the participant would score significantly better on function tests at the end of the Nordic walking phase than the washout and ordinary walking phases. We also predicted that the participant's perceptions and experiences of Nordic walking and its effects on her physical and psychological well-being would be more positive than ordinary walking.

METHODS

Study Design

This mixed methods, single subject repeated measures ABACA design consisted of five six-week phases. The sequential order of the phases were: initial baseline (A), ordinary walking programme (B), ordinary walking washout (A), the Nordic walking programme (C), and Nordic walking washout (A). During the A phases (baseline and washout) the participant did not undertake a formal walking programme but no other restrictions were placed on her normal daily activities and exercise. Physical function was measured repeatedly throughout the study, and at the end of the study a semi-structured interview explored the participant's experiences and effects of the two types of walking.

Participant

The 64 year old female participant was diagnosed with Parkinson's disease 11 years ago. At the time of recruitment she was in fulltime employment, taking Sinemet medications, had no other medical disorders, and not involved in regular physical activity. Her Hoehn and Yahr score was 2.5 and the Mini Mental Score Examination (MMSE) was 29. Prior to diagnosis she was involved in competitive individual sports. During the study the participant's medications were not altered and she remained in good general health.

Walking Interventions

Ordinary and Nordic walking followed the same protocol, with the participant walking twice weekly for six weeks on predominantly flat pathways, commencing in a local park and progressing to roadside footpaths. Each session lasted an hour and consisted of a warm up, ordinary or Nordic walking and a cool down. A physiotherapist trained as a Nordic walking instructor, supervised the participant during the Nordic and ordinary walking sessions. For both the ordinary and Nordic walking, the participant walked with a reciprocal arm leg pattern. Nordic walking also involved the use of the specifically designed Nordic walking poles measured to suit the participant. For the last two weeks of the walking phases, the participant was encouraged to undertake one additional walking session per week without the supervisor, but accompanied by another person.

Measures

The 6MWT measured walking endurance, by recording the distance (metres) walked as quickly and safely as possible during the six minutes and the number of rests required (Hill et al 2005). The test has been shown to have high test-retest reliability (ICC=0.95) in people with mild to moderate Parkinson's disease (Canning et al 2006, Schenkman et al 1997).

The TUG test measured the ability to carry out sequential locomotor tasks, by timing how long it took for the participant to rise from sitting in a chair, walk three metres at a comfortable speed, turn, and return to the sitting position (Hill et al 2005). The test has high inter-rater reliability (ICC (3,1) = 0.999), and high test-retest reliability ($F(4,44) = 0.67$, $p = 0.613$) (Morris et al 2001).

The 10MWT measured timing and spatial aspects of walking. The participant walked as quickly as possible along a 12 metre flat walkway, with the middle 10 metres being timed. This test has high test-retest reliability in people with Parkinson's disease when tested seven days apart (ICC = 0.93) (Urquhart et al 1999).

The PDQ-39 is a list of potential difficulties people with Parkinson's disease may have encountered in their daily lives over the past month (Marinus et al 2002). It consists of eight subscales, but only the 10-item mobility and six-item activities of daily living scales were used, because they evaluate physical function. The participant responded to the items using a five point Likert scale to indicate the extent of difficulty she experienced with each activity (*never* = 1 to *always* = 5). Examples of the items were *had difficulty doing the leisure activities which you would like to do* (mobility subscale) and *had difficulty dressing yourself* (activities of daily living). The PDQ-39 mobility and activities of daily living subscales have high internal consistency with Cronbach alphas of 0.89 and 0.83 respectively (Peto et al 1995).

The participant's age, sex, employment status, history of Parkinson's disease, current Parkinson's disease medications, other medical disorders, her current level of physical activity and that prior to her diagnosis of Parkinson's disease were recorded. The participant's cognitive mental status was tested using the MMSE (Crum et al 1993), and the level of her Parkinson's disease related disability was scored using the Hoehn and Yahr staging scale (Stebbings and Goetz 1998).

Procedure

Ethical approval was obtained from the Auckland University of Technology Ethics Committee. Prior to giving written informed consent, the participant was provided with verbal and written information about the study procedures and her role in it.

Initially the participant completed the demographic and Parkinson's disease characteristics questionnaire. She was tested on the MMSE and the Hoehn and Yahr scale, and completed the PDQ-39 mobility and physical activity sub-scales, the TUG, 10MWT and the 6MWT. Then the six week phases commenced with the participant being measured weekly on the TUG, 10MWT and the 6MWT. These measurements were conducted at the same time of day, and along the same carpeted walking track. At the end of each study phase she completed the two PDQ-39 sub-scales. The number of walking sessions was recorded at the end of each walking phase.

Following the Nordic walking washout phase, a semi-structured interview (45 minutes) was held, that used an interview schedule to explore the participant's experiences with both forms of walking, and her perceptions of how each affected her physical and psychological well-being. Open ended questions were the triggers for discussion, such as 'How did you find it walking with the Nordic poles as compared with ordinary walking?', 'What other aspects of your life have been influenced by Nordic walking?' and 'What do you think that contributed most to your continuing to Nordic walk?'. The participant's interview was digitally recorded and transcribed by one of the researchers.

Data Analysis

Statistical data were analysed descriptively using SPSS version 17, with the study-wise alpha set at 0.05. The number of completed sessions for each form of walking was compared with the number of prescribed walking sessions. Means and standard deviations were calculated for the TUG, 10MWT, the 6MWT and the PDQ-39 mobility and activities of daily living subscales for each of the study phases.

To test the prediction that the participant would score significantly better on physical function tests during and following the Nordic walking phase than the washout and ordinary walking phases, repeated measures within subjects analysis of variance (ANOVA) were undertaken. When significant differences were found for these analyses, post-hoc paired *t*-tests were conducted. Bonferroni corrections were used to reduce Type 1 errors, with the test-wise alpha level being set at 0.01 for the analysis of the TUG, 10MWT and 6MWT as there were five comparisons. These comparisons were between sequential phases, baseline with ordinary walking, ordinary walking with its washout, ordinary walking washout with Nordic walking, and Nordic walking with its washout; and between ordinary and Nordic walking. The TUG, 10MWT and 6MWT data for each phase were graphed with the inclusion of trend lines.

The adjusted test-wise alpha level for the PDQ-39 subscale analyses was set at 0.008 because there were six comparisons between beginning and end of baseline, end of baseline and ordinary walking, end of ordinary walking and ordinary walking washout, end of ordinary walking washout and Nordic walking, and end of Nordic walking and Nordic walking washout; and between the end of the ordinary walking and Nordic walking phases.

Initially the three researchers independently read the interview transcript, and then used content analysis to identify meaningful units that explained the participant's perceptions and experiences of Nordic and ordinary walking. Then the researchers met to compare their individual analyses looking for similarities and differences. Where there were differences these were discussed to reach a consensus. Finally the resultant themes and descriptions were validated in discussion with the participant.

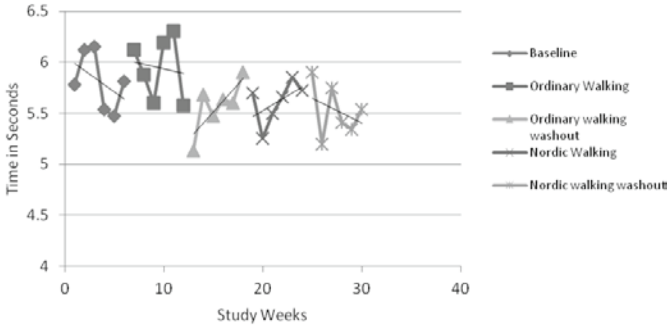
RESULTS

The participant attended all the prescribed sessions for each form of walking.

Physical Function

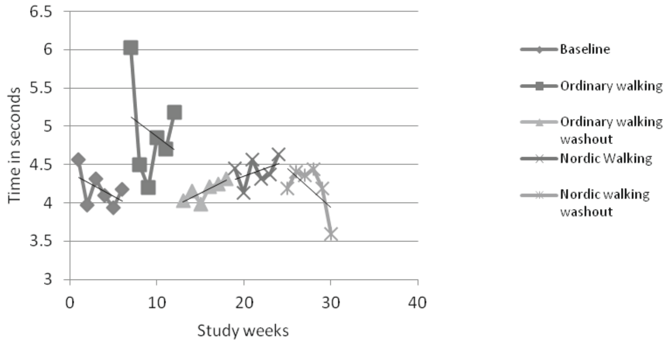
The scores for the TUG showed very little variation ranging from 5.20 seconds to 6.31 seconds (see Figure 1). There was very little difference in time taken to complete the TUG during each phase. The repeated measures ANOVA showed no significant differences for TUG between each of the phases ($F(4,2) = 3.36$, $p = 0.226$).

Figure 1: Weekly Timed Up and Go measurements during each study phase.



The scores for the 10MWT ranged from 6.31 seconds to 3.59 seconds, and as can be seen in Figure 2 the times for the ordinary walking phase were slightly longer than the other four phases. No significant differences were found between the scores on the 10MWT for each phase ($F(4,2) = 30.96$, $p = 0.032$).

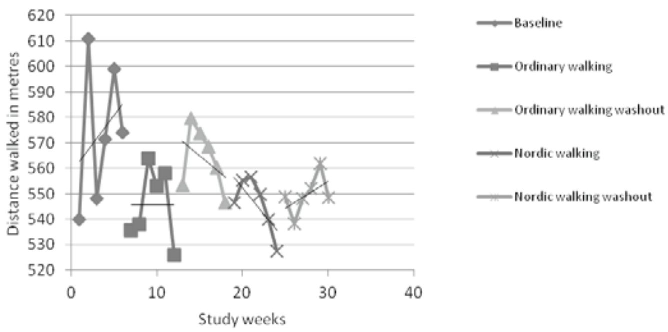
Figure 2: Weekly Ten Metre Walk Test times during each study phase.



The distances walked in the 6MWT ranged from 525.8 metres to 610.7 metres (Figure 3). While there was some variation within each phase for the distance walked, the trend line for the baseline data indicated slightly longer distances than the other four phases. The repeated measures ANOVA did not reveal any significant differences in the 6MWT scores ($F(4,2) = 24.76$, $p = 0.039$).

The repeated measures ANOVA revealed a significant difference in the PDQ-39 mobility scale scores ($F(5,5) = 19.00$, $p < 0.003$). Post-hoc paired *t*-tests identified only one significant difference, which occurred between the PDQ-39 mobility scores at the end of the Nordic walking and the Nordic walking washout phases ($t(9) = 1.22$, $p < 0.001$). The repeated measures ANOVA of the PDQ-39 activities of daily living subscale revealed no significant difference ($F(4,2) = 0.85$, $p = 0.605$).

Figure 3: Weekly Six Minute Walk Test distances measured during each study phase.



As can be seen in Table 1 the means for the PDQ-39 mobility and activities of daily living scales were low with very little variation amongst them.

Table 1: Descriptive statistics for the PDQ-39 mobility and activities of daily living subscales

	PDQ-39 Mobility Subscale	PDQ-39 Activities of Daily Living
Beginning of study	1.50 SD 0.53	1.50 SD 0.84
End of baseline	1.10 SD 0.32	1.50 SD 1.22
End of ordinary walking	1.10 SD 0.32	1.50 SD 0.55
End of ordinary walking washout	1.40 SD 0.70	1.33 SD 0.82
End of Nordic walking	0.90 SD 0.32	1.67 SD 1.21
End of Nordic walking washout	0.20 SD 0.42	1.00 SD 1.26

Participant's Experiences of the Walking and the Effects on her Health and Wellbeing

The interview content formed three categories.

Experiences of the Nordic walking programme: The participant reported that it was important for her to undertake the Nordic walking programme with a trained instructor with clinical knowledge of Parkinson's disease, because she did not have to justify her symptoms. The progressive manner in which the walking phases were implemented gave the participant confidence with her walking:

> *Starting on flat surfaces first, that are not near road traffic - like at the park and university grounds, meant I could concentrate on Nordic walking; I didn't need to think about where I was going... That helped with my confidence so that I was not distracted by all the road noises and people going past. After six weeks, I became less conscious of the poles; I did not need to think all the time about how to walk with them. The poles became an extension of my arms. Once I had mastered all of what is involved, I found I was self-correcting and walking quite confidently.*

She also noted that it was easier for her if the supporting person walked in front rather than beside or behind: *"Then I could match their stride and focus on walking 'right' and not be distracted as so easily happens when one has PD"*. In addition, walking with a designated person meant that the participant was committed to undertake the prescribed programme:

> *I think having a commitment to meet someone at a specific planned time was most important. Let's face it; what I really felt like doing some mornings was to stay in bed! It would have been easy to make excuses to myself if I did not know I had to meet you.*

General health: The participant noted that over the Nordic walking phase, changes occurred in her general wellbeing especially with her appetite, sleep and energy levels. With regard to appetite, the participant commented: *After a couple of weeks of Nordic walking I actually felt hungry again! ... I hadn't realized that I had not felt that for a while.* Changes occurred with her sleep: *I had been worried about having to use sedatives to sleep. A few weeks into the programme... I cut my dose and found I was able to get back to sleep after waking in the night.* Four months after completing the programme, the participant was not taking sedatives and was sleeping better.

The participant reported improved energy levels:

> *Initially when I started the walking phase of the programme I came back to work feeling quite tired. So I would rest and even go to sleep for 20 minutes or so. By the last two weeks of the Nordic walking phase I actually felt more energized! I would ... get through an afternoon of work without needing a rest. My mind functioned better.*

Physical and psychological wellbeing: When using the poles the participant found she could overcome some of her physical and psychological limitations due to Parkinson's disease:

> *I am surprised at how much it has helped with my walking and balance. ... It helped me regain things I didn't know I had lost. ... I started feeling my body again. Before, when I was walking, I had to stay inside my body to make sure I didn't slip and so on. Now I am actually using my body again. So instead of being trapped inside myself, I feel freer. With my poles I feel more confident. I stride more and am not so tempted to take those Parkinsonian small steps. ... Now I am not thinking 'Oh oh, I am going to slip' or 'Oh oh, I am going to fall over'.*

The participant was able to go to places that she could not previously, which broadened her social participation:

> *The poles opened up my world again. I am not so overwhelmed on social occasions. I used to hesitate going where I knew there was going to be a crowd – especially if there was a possibility that there would not be seats provided. Now I just take my poles and use them as supports and that helps. ... When I have my poles, I am more confident to try walking on surfaces that would have made me hesitate before. Even gravel tracks on hills... I am also more confident to look around me when I am walking. Not just at my feet and the path right in front of me. Instead of just hearing the birds, I can now look at them.*

When not using the poles, improvements were also found in everyday activities:

> *Nordic walking changed the way I do things – the way I move without the poles – getting out of bed or up from a chair, walking up and down stairs, and getting dressed. I do these things more easily and quicker now.*

She also reported that her general fitness improved and her competitive nature was rekindled as a consequence of the Nordic walking:

> *It made my body work harder – it got me fitter. I guess the swinging of my arms, conscious movement of my hips and striding out more. I puff more too. I don't get so dizzy either...During the walking programme I found myself constantly competing with myself – could I walk further and walk faster and so on. I like the feeling of being challenged and challenging myself.*

DISCUSSION

Our findings did not support the prediction that the participant would score significantly better on the function tests (TUG, 10MWT, 6MWT and the PDQ-39 mobility and activities of daily living subscales) during and following the Nordic walking phase than the washout and ordinary walking phases. The only comparison that did show a significant difference was between the PDQ-39 mobility subscale scores at the end of the Nordic walking and Nordic walking washout phases, but this was not in the anticipated direction. The graphed data revealed that in comparison to the two walking phases, the participant was slightly quicker on the TUG and the 10MWT, and she walked further in the 6MWT in the washout phases. Conversely, she had positive perceptions of Nordic walking, both physically and psychologically. There are aspects of our study and its contradictory findings that warrant discussion.

The use of a mixed methods design provided an insight into the participant's experiences of Nordic walking and its effects on her wellbeing that would not have been possible by using solely quantitative measures. van Eijkeren et al (2008) suggested that the positive effects of Nordic walking on people with Parkinson's disease could be due to an improvement in their general health, and the provision of rhythmic cueing. Our participant's interview comments support these notions. She noticed an improvement in her general health during the Nordic walking because she felt she had more energy, over time she did not need to rest after the Nordic walking sessions, and her quality of sleeping improved.

The benefits of Nordic walking also extended into her everyday activities, with her reporting that she was able to get out of bed more easily, which is a known difficulty for people with Parkinson's disease (Levine et al 2000). By walking behind the supervisor, she was able to match her stride which could be indicative of either imitation or external cueing (Kukkonen-Harjula et al 2007). Further, by the end of the six weeks of Nordic walking she realised that she did not have to think about walking with poles, suggesting that Nordic walking became a more automatic behaviour with practice. However, this automaticity could also have been caused by the progressive manner in which she was introduced to Nordic walking (Magill 2011). The participant found that commencing the Nordic walking on flat surfaces in quiet areas, such as parks, allowed her to concentrate on learning this form of walking, which in time enabled her to progress to walking on uneven terrain and in busier areas. In addition, walking with the supervisor had a positive effect on her adherence to the walking programmes, because she had committed to meeting with a person at a specified time, which is a known facilitator of exercise adherence (Sniehotta et al 2005).

Our study's measures were chosen because they had previously shown differences in physical function following physical activity interventions for people with Parkinson's disease (Ebersbach et al 2010, Kluding and McGinnis 2006, Reuter et al 2006, van Eijkeren et al 2008). Nonetheless our participant's scores on the TUG, 10MWT and the 6MWT did not differ significantly between the study phases. Her scores on each of these measures were either better than or within the norms for people of her age; the TUG times were quicker than those of community dwelling women of her age (8 SD 2 seconds) (Steffen et al 2002); her 6MWT distances were within the range (53 SD 92 metres) for healthy community dwelling females aged 60 to 69 years (Steffen et al 2002); and her 10MWT times were faster than the mean group scores (7.90 to 6.58 seconds) in the Ebersbach et al (2010) study. Similarly, our participant's PDQ-39 mobility and activities of daily living subscales scores were low, indicating that she experienced few problems with these activities.

There are four possible reasons for our participant's better than expected test scores. First, she exhibited a competitive attitude to the tests, which may have been a reason for the lack of stability in the 6MWT distances during the baseline phase. Second, the six week duration of the two walking programmes may not have been long enough to show any significant differences between them. Third, the TUG and the 10MWT may not be able to show the full effect of Nordic walking on the physical function of people with mild to moderate Parkinson's disease. Instead, the assessment of these peoples' physical fitness might be more suitable. While the 6MWT does measure physical fitness, the use of the Åstrand-Rhyming test would provide more precise information about the participants' cardiovascular fitness. This test has been successfully used for this purpose with people with Parkinson's disease (Levine et al 2000), and would further strengthen the measurement of endurance. Moreover, the TUG and 10MWT only assess a single task, and are not designed to evaluate the physical abilities required to perform everyday activities (Schenkman et al 2002). An observational measure, such as the Continuous Scale Physical Functional Performance 10-item version (CS-PFP-10, Cress et al 2005) may be more appropriate. This measure consists of 10 daily activities, presented in an incremental order, and has been successfully used in the community (Cress et al 2005). Fourth, weekly measuring of the TUG, 10MWT and 6MWT throughout the entire duration of the study may have led to a practice effect, which may have been responsible in part for these tests' high scores.

This study's strengths were the mixed methods design which provided a broad perspective of the effects of Nordic walking, and the repeated measurement of physical function throughout each phase of the study which enabled robust statistical analysis of these data. The limitations were the sample size of one, the use of single task measures of physical function, and the short duration of the walking programmes.

In light of the limitations of this study the findings should be applied clinically with caution. Nonetheless, the increasing popularity of Nordic walking for people with Parkinson's disease and its reputed beneficial effects point to it being appropriate for inclusion in physiotherapy programmes. Physiotherapists' knowledge of clinical and exercise science makes them ideally suited to become involved in Nordic walking, and to use it to improve the physical fitness of people with mild to moderate Parkinson's disease.

As a pilot study it has highlighted a number of areas that should be addressed in future research into Nordic walking for people with mild to moderate Parkinson's disease. Using a mixed methods design that involves comparing ordinary and Nordic walking over a period of two to three months should enable the true worth of the intervention to be shown. Measurements should be taken at the beginning and end the walking programmes, and at a follow-up time. The measures should include objective tests of daily activities and physical fitness; and the use of a semi-structured interview to explore physical and psychological wellbeing. To ensure that participants are walking at a maximal yet safe intensity, they should base their perceived exertion on the aerobic capacity test results (Levine et al 2000).

In conclusion, no significant differences in the predicted direction were found on the physical function tests between any of the sequential study phases and the two forms of walking, which may be due in part to the measures used and their timing. However the participant perceived Nordic walking was beneficial physically and psychologically, and that these benefits extended into her everyday activities. Finally future research should compare Nordic walking with ordinary walking using a mixed methods design, and include objective observational measures of daily functional activity and physical fitness.

KEY POINTS

- No significant improvements in physical function were found following either ordinary walking or Nordic walking.
- The participant reported that during the Nordic walking phase her general health and physical and psychological wellbeing improved, but this did not occur during the ordinary walking phase.
- The non-significant findings may be due to the physical function tests not being comprehensive enough to show change in activities of daily living.
- Nordic walking could be part of physiotherapy exercise programmes designed to maintain physical fitness in people with Parkinson's disease.

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REFERENCES

Baatile BS, Langbein F, Weaver C, Maloney MS and Jost MD (2000) Effect of exercise on perceived quality of life of individuals with Parkinson's disease. *Journal of Rehabilitation Research and Development* 37: 529-534.

Canning CG, Ada L, Johnson JJ and McWhirter S (2006) Walking capacity in mild to moderate Parkinson's disease. *Archives of Physical Medicine and Rehabilitation* 87: 371-375.

Cress ME, Petrella JK, Mooore TL and Schenkman M (2005) Continuous-Scale Physical Functional Performance Test: Validity, reliability, and sensitivity of data for short version. *Physical Therapy* 85: 323-335.

Crum RM, Anthony JC, Bassett SS and Folstein M (1993) Population-based norms for the Mini-Mental State Examination by age and educational level. *Journal of American Medical Association* 269: 2386-2391.

Ebersbach G, Ebersbach A, Elder D, Kaufhold O, Kusch M, Kupsch A and Wissel J (2010) Comparing exercise in Parkinson's disease - The Berlin LSVT®BIG study. *Movement Disorders* 25: 1902-1908.

Hill K, Denisenko S, Miller K, Clements T and Batchelor F (Eds) (2005) Clinical outcome measurement in adult neurological physiotherapy (3rd ed). Melbourne, Australia: Australian Physiotherapy Association National Neurology Group.

Kluding P and McGinnis PQ (2006) Multidimensional exercise for people with Parkinson's disease: A case report. *Physiotherapy Theory and Practice* 22: 153-162.

Kocur P, Deskur-mielecka E, Wilk M and Dylewicz P (2009) Effects of Nordic Walking training on exercise capacity and fitness in men participating in early, short-term inpatient cardiac rehabilitation after an acute coronary syndrome - a controlled trial. *Clinical Rehabilitation* 23: 995-1004.

Kukkonen-Harjula K, Hiilloskorpi H, Mänttäri A, Pasanen J, Parkkari J, Suni J, Fogelholm M and Laukkanen R (2007) Self-guided brisk walking training with or without poles: A randomized-controlled trial in middle-aged women. *Scandinavian Journal of Medicine and Science in Sports* 17: 316-323.

Levine S, Brandenberg P and Pagels M (2000) A strenuous program benefits patients with mild to moderate Parkinson's disease. *Clinical Exercise Physiology* 2: 43-48.

Magill RA (2011) Motor learning and control: Concepts and applications. (9th ed). New York: McGraw-Hill.

Marinus J, Ramaker J, van Hilten J and Stiggelbout AM (2002) Health related quality of life in Parkinson's disease: A systematic review of disease specific instruments. *Journal of Neurology, Neurosurgery and Psychiatry* 72: 241-248.

Morris S, Morris ME and Iansek R (2001) Reliability of measurements obtained with the Timed Up & Go test in people with Parkinson's disease. *Physical Therapy* 81: 810-818.

Peto V, Jenkinson R and Greenhall R (1995) The development and validation of a short measure of functioning and well being for individuals with Parkinson's disease. *Quality of Life Research* 4: 241-248.

Reuter I, Leone P, Schwed M and Oeschsner M (2006) Effect of Nordic walking in Parkinson's disease. *Movement Disorders* 21: S567.

Schenkman M, Cutson T, Kuchibhatla M, Chandler J and Pieper C (1997) Reliability of impairment and physical performance measures for persons with Parkinson's disease. *Physical Therapy* 77: 19-27.

Schenkman M, Cutson T, Kuchibhatla M, Scott BL and Cress ME (2002) Application of the Continuous Scale Physical Functional Performance test to people with Parkinson Disease. *Neurology Report* 26: 130-138.

Sniehotta FF, Schwarzer R, Scholz U and Schüz B (2005) Action planning and coping planning for long-term lifestyle change: Theory and assessment. *European Journal of Social Psychology* 35: 565-576.

Stebbings GT and Goetz CG (1998) Factor structure of the Unified Parkinson's Disease Rating Scale: Motor examination section. *Movement Disorders* 13: 633-636.

Steffen T, Hacker T and Mollinger L (2002) Age and gender-related test performance in community-dwelling elderly people: Six-Minute Walk Test, Berg Balance Scale, Timed Up & Go Test, and gait speeds. *Physical Therapy* 82: 128-137.

Urquhart DM, Morris ME and Iansek R (1999) Gait consistency over a 7-day interval in people with Parkinson's disease *Archives of Physical Medicine and Rehabilitation* 80: 696-701.

van Eijkeren FJM, Reijmers RSJ, Kleinveld MJ, Minten RN, ter Bruggen JP and Bloem BR (2008) Nordic walking improves mobility in Parkinson's disease. *Movement Disorders* 23: 2239-2243.

Employers' perspectives of competencies and attributes of physiotherapy graduates: an exploratory qualitative study

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ABSTRACT

Undergraduate physiotherapy programmes aim to equip graduates with basic skills, knowledge and behaviours to allow them to enter the profession. The aim of this study was to explore employers' perceptions of key factors in work place preparedness of novice physiotherapists. Four employers of recent graduates participated in a focus group interview. The analysis resulted in three themes: professionalism, perspective and confidence. Professionalism related to the importance of generic skills and attitudes, including enthusiasm, work-ethics, flexibility, empathy and energy. Employers assumed a level of competence in novice physiotherapists as all had met the professional registration criteria. Perspective related to the employers' perceptions that the graduates had difficulties changing from a focus on their personal and professional needs to an external focus, such as on the needs of patients, colleagues and the workplace. Confidence was seen to be low in new entrants with regard to how they saw the profession and their own skills and knowledge. These results highlight the importance of facilitating these generic skills in the undergraduate programmes to improve the work place preparedness of new physiotherapy graduates. However, time and experience in work will still be needed by graduates to gain broader perspectives and confidence, and situated mentorship could facilitate the required professional formation.

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Key words: Higher education, Physiotherapy, Confidence, Professionalism, Competence

INTRODUCTION

The primary aim of any professional academic curricula is to prepare students for the demands of their occupation following graduation. The undergraduate programmes at Physiotherapy Schools within New Zealand are audited by the Physiotherapy Board of New Zealand on an annual basis to ensure that the defined competencies and requirements for registration of graduates are met for subsequent employment (Physiotherapy Board of New Zealand 2009). The adoption of such standards enables physiotherapy graduates to practice as autonomous practitioners, applying knowledge and skills within various workplace settings (Physiotherapy Board of New Zealand 2009).

The World Confederation of Physical Therapy (2007) has developed international standards in order to ensure a high quality service to society. These standards are expected to be adhered to by all physiotherapists, whether they are specialists or newly qualified, and include aspects of "*administration and practice management, communication, community responsibility, cultural competence, documentation, education, ethical behavior, informed consent, legal, patient/client management, personal/professional development, quality assurance, research and support personnel*" (World Confederation of Physical Therapists, 2007, p 1).

It is recognised that new graduates need a range of generic skills and knowledge, including interpersonal skills and the ability to work as an interdependent team member, in addition to technical generic and discipline-specific competencies (Higgs 1999). Thus, undergraduate programmes include theoretical and occupation-specific skills, as well as a number of interpersonal and generic skills such as communication, decision making and critical thinking in order to prepare new graduates to enter the workforce (University of Otago 2005). These more generic graduate attributes have been described in many other professional fields (Zaharim et al 2009, Zehrer and Mössenlechner 2009) and identified by employers as being key factors in the employability of new graduates (Zaharim et al 2009, Zehrer and Mössenlechner 2009).

Previous studies investigating physiotherapy curricula have evaluated the effects on learning styles (Kell and van Deursen 2002, Kelly 2007, Van Langenberghe 1988) and academic beliefs (Kell and van Deursen 2002, Kelly 2007). While the effectiveness of medical curricula to prepare students for clinical practice has received attention (Bleakley and Brennan 2011), the literature on the effectiveness of physiotherapy curricula for the preparation of workforce requirements is scarce. To the authors' knowledge no research has investigated the employers' perspectives of preparedness of new physiotherapy graduates for practice.

Approximately 120 students graduate as physiotherapists from the University of Otago each year. Feedback from employers is important to determine whether these graduates meet the demands of the work place, and also to provide information for the students relating to future employers' expectations. This information could also be relevant for the employers to reflect on their own values when employing recent graduates. The aim of this study was, thus, to gain an understanding of employers' perspectives of workplace preparedness of recent physiotherapy graduates from the University of Otago.

Background

The Bachelor programme of Physiotherapy (BPhty) at the University of Otago is a four year education. The first year focuses on Health Science, and Years 2 and 3 are predominantly physiotherapy-based with components of clinical practice. The fourth and final year of the programme focuses on clinical practice, consisting of four 6-week placements in Musculoskeletal physiotherapy, Neurorehabilitation, Cardiopulmonary rehabilitation/tertiary care, and community/primary care. The former three placements are assessed by a clinical supervisor throughout the period, in addition to a final clinical examination at the end of each of these placements. Students are required to complete a written assignment for the community placement. On graduation students enter the New Zealand workforce. According to statistics from the Ministry of Health, 54% of active physiotherapists work in private practice and 28% work for the District Health Board (DHB) within New Zealand (Ministry of Health 2010).

METHODS

Design

A focus group interview with employers of recent Otago graduates was undertaken as it generates debate, and has been shown to be an effective way of understanding perceptions, interpretations and beliefs of group members (Liamputtong 2009). Focus groups normally consist of 6-8 people from similar professional backgrounds and have similar experiences. The purpose of a focus group is to discuss a specific issue with the help of a moderator and draw on group interaction to create new thinking and knowledge (Morgan 1997, Krueger and Casey 2009).

Procedures

The methods of this study were reviewed and approved by the University of Otago Human Ethics Committee. Thirteen recent graduates (1-year post-graduation) of the School of Physiotherapy at the University of Otago, who formed part of a cohort from a larger study evaluating the School curriculum, forwarded contact details of their employers. For the purposes of this study all employers were required to have employed a graduate from the BPhty programme at the School of Physiotherapy at the University of Otago within the last five years. Information regarding this study and invitations to participate were sent to twelve employers who had previously agreed to take part in a larger study investigating the effectiveness of the programme for clinical practice. Four of these employers were available and agreed to participate in the focus group (3 female, 1 male) and signed a consent form prior to entering the study. Two of the four participants worked at a DHB, one at a university teaching clinic and one in private practice. Three were from the South Island and one from the North Island. The range of years in professional experience ranged from 10 to more than 30 years.

The focus group was conducted at the School of Physiotherapy in Dunedin. Three participants joined the group in person and one by teleconference. Four researchers were present, two of whom (JH, JJ) were undergraduate physiotherapy students from the University of Umeå, Sweden. They attended as observers and were subsequently involved with the analysis of the interview. They did not participate in the interview and the interviewees were informed of the purpose of their presence.

Six questions provided a catalyst for exploratory discussions:

1. What are some of the qualities and skills that define for you a competent new graduate physiotherapist?
2. What are the qualities and skills that you expect when employing new graduate physiotherapists?
3. What are some of the key strengths that you have experienced with our new graduates?
4. What are some of the key weaknesses that you have experienced with our new graduates?
5. Do you consider that the new graduate students whom you have employed have been adequately prepared for clinical work?
6. Can you tell us some of the key ways in which you have had to support new graduates in developing competencies as a physiotherapist?

The discussion lasted one hour, was audio-recorded and transcribed verbatim.

Analysis

On completion of the interview, the leader of the focus group (PH) and two other attendees of the interview (JJ and JH) met to discuss the key points and emerging themes. The audio-recordings were then transcribed and the three researchers (JJ, JH and PH) independently coded the data by reading all the transcripts and field notes many times to note key words expressed by the participants and giving names to themes in the data (Liamputtong 2009). Initial themes were developed independently by three researchers (PH, JJ, JH). Multiple coding was used as described by Johnson and Waterfield (2004). Each researcher independently analysed and developed individual codes and themes that were then compared through regular meetings whereby quotes were chosen to appropriately represent and explain the evolving themes. Once consensus across the themes was reached, a peer-review of the themes was undertaken (GS) to test the credibility of the findings. Further to this, the themes were sent to an experienced qualitative interviewer (TH) for further review and feedback was then incorporated into the thematic analyses. This process ensured the rigour of the results and reduced bias from the researchers' personal interests (Burnard et al 2008, Johnson and Waterfield 2004). The reviewed themes were then sent to the interviewees for member-checking, and three replies were received signaling agreement. This technique further ensured credibility by re-confirming the interpretation of the focus-group discussion (Johnson and Waterfield 2004, Liamputtong 2009).

RESULTS

Three main themes emerged from the analysis; professionalism, perspective and confidence.

Professionalism

The interviewees generally perceived graduates of the University of Otago to be competent clinicians with the required level of skills for the workplace. As the graduates were registered by the Physiotherapy Board of NZ, the employers expected them to hold sound basic competencies.

> *"[…] so what you expect is that they're* [the graduates] *competent because they're registered […]."* (Participant D)

The employers valued non-clinical, personal attributes such as enthusiasm for the profession, good communication skills, empathy and energy as important skills for employment. These professional attributes were seen as not necessarily linked to clinical knowledge and skills.

> *"[…] yes you´re right, the clinical skills for the grounding and that's what you need but then probably the things that we look for and that stands out as everything we've said, it's those non-clinical* [skills] *[…]."* (Participant D)

Clinical expertise was not expected of recent graduates by the employers. They indicated that they could teach the graduates the additional basic skills required for their specific workplaces if they (the graduates) possessed the earlier mentioned personal attributes.

> *"I'm looking for enthusiasm and I'm not looking for expertise, I'm looking for enthusiasm, energy, empathy and an understanding of ethics and given anyone with those in the clinical, we can teach them the basic skills if they've got the science background and our interview is all about interpersonal factors and their ability to get on in a multidisciplinary team."* (Participant B)

Perspective

The employers valued graduates who understood and appreciated that they were part of a bigger picture, had an understanding of their responsibilities within the workforce, the community and the wider health context. In such a way they felt that graduates needed to shift focus in order to provide a good service to the patient, employer, and the workplace organisation.

> *"it's all about me* [the graduates] *and my needs and my learning and developing to the place, actually I'm a paid employee, to me it's about providing a good service to my patients, to my employer or the organization I work for."* (Participant C)

The employers perceived that recent graduates often had difficulty realising that the focus was no longer on them. The students need to understand the environment they are going to work in.

> *"I think around education, it's making sure that they understand they do have a role in this [the wider context of healthcare], so that they come out with an understanding of the environment that they're coming into so they need to understand what their role is and advocating for physio as a profession, and a knowledge of the current kind of political and health policy climate."* (Participant D)

Confidence

The employers perceived that graduates had concerns of confidence in themselves, in the profession and in the skills and knowledge they possess. Although the graduates were considered competent by the employers; there appeared to be a conflict between their level of skill and their level of confidence in the profession.

> *"To me the key thing in a new graduate is confidence in the profession that they'd chosen to be a part of and I see at the moment, there's a huge imbalance between competence and confidence with them being low in confidence in the profession."* (Participant B)

Further, the employers suggested that low confidence may be due to a lack of previous work experience or other qualifications. It is thought that this lack of experience can contribute towards difficulty in making decisions within reasonable time when assessing patients, with less time available for offering treatment or advice.

> *"[…] and I have noticed some of the staff who have had a previous job or a previous degree such as PE prior to coming in often have more confidence in themselves so potentially are willing to reach those conclusions earlier […]."* (Participant C)

DISCUSSION

This is the first study, to our knowledge, investigating employers' perceptions of the competencies and key attributes in recent physiotherapy graduates from the University of Otago in New Zealand. Importantly, the employers reported that graduates were meeting their expectations regarding practical clinical skills required for their respective work places. They were confident that the curriculum provided the graduates with the skills to work as physiotherapists, although expertise was not initially expected or required. The important themes that emerged were not related to clinical skills and knowledge, rather to issues of professionalism and professional behaviour, graduates' confidence in themselves and the profession, and their focus and perspective. These key issues were perceived by the interviewers to be important for integrating successfully into the work place as a competent physiotherapist.

The theme of professionalism included a range of non-clinical skills, rather than a focus on clinical skills and knowledge. The employers reported attributes such as enthusiasm, work-ethic, flexibility, empathy and energy to be important to them when deciding on the employment of a new physiotherapist. In a study by Lopopolo et al (2004) 34 physiotherapy managers ranked communication and professional involvement as one of the most important skills for physiotherapists when entering their first employment. Interestingly, a similar range of graduate qualities was identified for employment in the fields of tourism and engineering (Zaharim et al 2009, Zehrer and Mössenlechner 2009) demonstrating that these attributes are perhaps generic and transferrable into other non-related fields. Employers felt that these generic personal skills were more relevant when making decisions on employment selection than the actual level of clinical skills and competencies attained by the graduates. These perceptions support findings from a previous qualitative study by Ajjawi and Higgs (2008), exploring how experienced physiotherapists learned to reason in clinical practice. These authors described interpersonal skills, including communication, collaboration and critical self-evaluation, as important skills and attributes to be included in the curricula of the undergraduate physiotherapy programme to better prepare students for employment (Ajjawi and Higgs, 2008). Jones et al (2010) explored the preparedness of final year physiotherapy students for their progression into employment, also mentioned the importance of focussing on these skills in under-graduate education to meet the employer expectations. Those authors highlighted that the analysis and assimilation of these skills cannot be assumed (Jones et al 2010).

Issues of confidence were identified within three areas: within the profession, the physiotherapists themselves and in their skills and knowledge. Although the employers suggested that new graduates were clinically competent, they felt that a number of them lacked confidence in the workplace. Kidd et al (2011) reported that student confidence had its foundation in theoretical knowledge and skills, and was important for professional development (Hecimovich and Volet 2010, Lindquist 2004). These results suggest that graduates may lack awareness in their clinical competence and knowledge. Black et al (2010) explored novice physiotherapists' experiences, learning and development in their first year of clinical practice and found the novice physiotherapists' lack of self- awareness in their abilities and competence was associated with lower self-confidence. Thus, these findings suggest that confidence does not necessarily reflect the level of competence, rather that such confidence issues may be linked to a lack of self-awareness.

Black et al (2010) also found that novice physiotherapists were likely to have increased confidence after positive interactions with patients and other professionals. Thus, peer support, mentoring and positive re-enforcement are likely to be key factors in developing self-awareness and confidence in new graduates. In some of the workplaces represented by the focus group members, mentoring programmes were used to contribute towards a smoother transition into work life and the profession. Wainwright et al (2011) describes the importance of mentorship for developing decision making skills as a cornerstone of effective patient care because mentors facilitate attributes such as effective communication, commitment to learning, and confidence. Similarly studies of novice nurses showed that six months to one year of work in the clinical environment increased both professional behaviours and confidence (Black et al 2010, Clark and Holmes 2007). This emphasizes the importance of time and clinical experience to strengthen confidence**.** It also suggests that whilst generic attributes can be developed within an undergraduate programme, they require further development and facilitation on employment.

New graduates were also perceived to have an introspective focus, focusing on their own needs as the employee, with a consequent lack of knowledge and perspective of their role as an employee within the wider health care system. Black et al (2010) reported from a longitudinal analysis of novice physiotherapists over a year that their focus shifted from thinking about self as a practitioner to being more patient-centred. Time and experience were seen as key drivers for this. Considering these findings, it is perhaps not surprising that the employers found that students were often thinking about their needs and so they valued those who were able to look at the broader perspective and their role as an employee. Although the final year of study of the undergraduate programme is spent working in clinical environments, it is concerned with student assessments and strategies to ensure that the competencies for the placement are met. It may not adequately prepare students for the requirements of a new employer. A shift in perspective may be seen as a natural progression when entering employment and working as a physiotherapist (Black et al 2010). However, the present study shows that the University and working community may need to collaborate in order to gain an understanding of how graduates meet expectations and provide high quality physiotherapists.

The findings from this study are confined to students who graduated from the University of Otago in New Zealand and cannot necessarily be transferred into other contexts. However, it is probable that similar findings would be expected in countries with similar education systems and work environments to that of New Zealand. Additionally, further research is required to look at competencies of new graduates in other countries with different physiotherapy education programmes and work environments, particularly with the possible advent of graduate entry, masters and doctoral level physiotherapy programmes. This study only examined the competencies of the new graduates from the employers' perspective and it would also be interesting to look at the integration into the workforce from the new graduate perspective.

The rigour and trustworthiness of the focus group data was ensured by multiple coding, peer reviewing and member checking (Burnard et al 2008, Johnson and Waterfield 2004, Liamputtong 2009, Ryan and Bernard 2003). Although this exploratory study was limited to a small focus group, it included employers from several locations in New Zealand as well as variety of physiotherapy workplaces and settings.

The development of generic skills and knowledge is recognised as an important function of higher education (University of Otago Learning Plan 2008-2010). It is expected that many of these qualities will evolve and develop with maturity and as part of undertaking higher education (Barrie 2007). Our findings emphasise the importance of the development of such qualities in the training and assessment of physiotherapy students. It is also likely that requirements for employment may be modified with changes in the demographics of the population and the health care system. Thus, it is important for educators to maintain a dialogue with the community and employment stakeholders to continually ensure that new graduates meet the expectations and needs of the work place.

CONCLUSION

The findings of this study indicate that generic skills and attitudes such as enthusiasm, empathy, energy and a strong work ethic were used by employers in their selection of suitable candidates, rather than competence of clinical skills and knowledge. The focus group suggested that recent graduates needed to shift their focus from themselves to focusing on others, such as patients, colleagues and employers. The University may need to facilitate these generic skills and attitudes alongside the profession-specific clinical skills. To help graduates moving from novice to more experienced clinicians, mentoring programmes may be an effective way to enhance the required professional development in the early years of autonomous clinical practice.

KEY POINTS

- The physiotherapy graduates of the University of Otago were assumed to be competent by employers who took part in the focus group.
- Well-developed generic skills and attitudes were the factors that differentiated one graduate from another for employment suitability.
- Offering mentorship to the newly graduated physiotherapist in the workplace may contribute to the development of the required levels of professionalism.

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REFERENCES

Ajjawi R and Higgs J (2008) Learning to reason: a journey of professional socialisation. *Advances in Health Science Education Theory and Practice* 13: 133-150.

Barrie S (2007) A conceptual framework for the teaching and learning of generic graduate attributes. *Studies in Higher Education* 32: 439-458.

Black LL, Jensen GM, Mostrom E, Perkins J, Ritzline PD, Hayward L and Blackmer B (2010) The first year of practice: an investigation of the professional learning and development of promising novice physical therapists. *Physical Therapy* 90: 1758-1773.

Bleakley AB and Brennan N (2011) Does undergraduate curriculum design make a difference to readiness to practice as a junior doctor? *Medical Teacher* 33: 459–467.

Burnard P, Gill P, Stewart K, Treasure E and Chadwick B (2008) Analysing and presenting qualitative data. *British Dental Journal* 204: 429-432.

Clark T and Holmes S (2007) Fit for practice? An exploration of the development of newly qualified nurses using focus groups. *International Journal of Nursing Studies* 44: 1210-1220.

Ministry of Health (2010) Physiotherapist Workforce Summary Results from the 2009 Health Workforce Annual Survey. http://www.moh.govt.nz. (Accessed 16th September 2011).

Hecimovich MV and Volet S (2010) Development of professional confidence in health education Research evidence of the impact of guided practice into the profession. *Health Education* 111: 177-197.

Higgs JH, A. Higgs C and Neubauer D (1999) Physiotherapy education in the changing international healthcare and educational contexts. *Advances in Physiotherapy*: 17-26.

Johnson R and Waterfield J (2004) Making words count: the value of qualitative research. *Physiotherapy Research International* 9: 121-131.

Jones M, McIntyre J and Naylor S (2010). Are physiotherapy students adequately prepared to successfully gain employment? *Physiotherapy* 96: 169-175.

Kell CVD and van Deursen R (2002) Student learning preferences reflect curricular change. *Medical Teacher* 24: 32-40.

Kelly C (2007) Student's perceptions of effective clinical teaching revisited. *Nurse Education Today* 27: 885–892.

Kidd MO, Bond CH and Bell ML (2011) Patients' perspectives of patient-centredness as important in musculoskeletal physiotherapy interactions: a qualitative study. *Physiotherapy* 97: 154-162.

Krueger RA and Casey MA (2009) Focus Groups: A Practical Guide for Applied Research. 4th Edition, Sage Publications Inc.

Liamputtong P (2009) Qulitative Research Methods. Oxford University Press.

Lindquist I (2004) Early learning experiences valued by physiotherapy students. *Learning in Health and Social Care* 3: 17–25.

Lopopolo RB, Schafer DS and Nosse LJ (2004) Leadership, administration, management, and professionalism (LAMP) in physical therapy: a Delphi study. *Physical Therapy* 84: 137-150.

Morgan DL (1997). Focus Groups as Qualitative Research, 2nd Edition, Sage Publications Inc.

Physiotherapy Board of New Zealand (2009) Physiotherapy Competencies for physiotherapy practice in New Zealand. http://www.physioboard.org.nz/index.php? Physiotherapists. (Accessed 17th September 2011).

Ryan GWB and BernardR H (2003) Techniques to identify themes. *Field Methods* 15: 85-109.

Van Langenberghe HV (1988) Evaluation of students' approaches to studying in a problem-based physical therapy curriculum. *Physical Therapy* 68: 522-527.

Wainwright SF, Shepard KF, Harman LB and Stephens J (2011) Factors that influence the clinical decision making of novice and experienced physical therapists. *Physical Therapy* 91: 87-101.

University of Otago (2005). Teaching and Learning Plan (2005-2010) http://hedc.otago.ac.nz/tlp/introb.do?cms=public_access.los.otago.ac.nz. (Accessed 16th September 2011).

World Confederation of Physical Therapy (2007) Standards of Physical Therapist Practice. http://www.wcpt.org/policy/ps-standards. (Accessed 16th September 2011).

Zaharim A, Yusoff Y, Omar MZ, Johamed A, Muhamad N and Mustapha R (2009) Perceptions and expectation toward engineering graduates by employers: a Malaysian study case. *WSEAS Transactions on Advances in Engineering Education* 6: 296-305.

Zehrer A and Mössenlechner C (2009) Key competencies of tourism graduates: the employers' point of view. *Journal of Teaching in Travel and Tourism* 9: 266–287.

Home-based stroke rehabilitation using computer gaming

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ABSTRACT

This paper reports the findings of a case series of home-based bilateral upper limb rehabilitation using a motion-based computer game controller. Three individuals with chronic stroke and upper limb hemiparesis, who had previously participated in the initial trial of the system, continued rehabilitation for between 55 and 61 days at home, as recorded by diaries of use. Each participant was tested pre- and post-intervention using the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, and post-intervention, by the Intrinsic Motivation Inventory (IMI). Body function outcome measures were the Fugl Meyer Upper Extremity Assessment (FMA) and the Motor Assessment Scale (MAS). Although motor performance change was inconclusive, motivation assessment showed a trend of positive engagement, and the participants practiced unsupervised for 4.5 to 5.5 sessions per week over the duration of the trial, each achieving at least 33.5 hours of exercise.

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Key words: Stroke, hemiparesis, upper limb, rehabilitation, computer gaming

INTRODUCTION

Worldwide, about 15 million people per year suffer from a stroke (Mackay and Mensah 2004). Of the two thirds who survive, effects on body function (motor) commonly include muscle weakness, loss of range of motion, dyscoordination and spasticity, which often significantly limit activities of daily living and participation (Nakayama et al 1994, Werner and Kessler 1996). Following stroke, up to 85% of survivors initially show a motor deficit of the arm contralateral to the lesion. By six months, 30 to 66% of individuals still do not have functional upper limb activity (Richards et al 2008) and it is estimated that only 5 to 20% of people with stroke attain complete functional recovery of their affected upper limb (Kwakkel et al 2003).

Although most recovery of upper limb function occurs in the first three months after a stroke, significant gains in dexterity, strength and function with rehabilitation six months or more post-stroke, have been reported (Merians et al 2002, Werner and Kessler 1996). It is suggested that the application of rehabilitation techniques that enhance the brain's capability for neural plasticity and recovery after stroke, offer the best chance for upper limb functional recovery and motor relearning (Duncan et al 2005, Kleim and Jones 2008). Requirements for facilitating such neural plasticity are therapies that gain the attention of patients, and provide sufficient repetition and intensity of practice, i.e. duration and frequency of exercise (Henderson et al 2007, Kleim and Jones 2008, Krebs et al 2009, Kwakkel et al 2008, Sveistrup 2004).To gain or maintain attention, in a repetitive and functional/task-based way, requires exercises that are motivating and engaging (Merians et al 2002). Safely facilitating patients with stroke to complete a sufficient quantity of therapy that realises their true motor recovery potential can be achieved in a variety of ways. There appears to be little difference in the functional outcomes of a number of conventional stroke rehabilitation techniques, such as neurodevelopmental techniques and motor relearning (Saposnik et al 2011). Investigations into the contribution of newer technologies or approaches to stroke rehabilitation is warranted.

Computer-assisted virtual reality (VR) technology, although a relative newcomer to the stroke upper limb therapy tool box, shows promise. In a review of the effect of seven trials of VR on upper limb function, Laver et al (2011) found that VR was moderately more effective than conventional interventions, although small sample sizes and heterogeneity of interventions limited this interpretation. Although VR requires further investigation, it could potentially be integrated into conventional rehabilitation or be used alone when conventional rehabilitation is unavailable or restricted (Burdea and Coiffet 2003, Saposnik et al 2011). Low-cost, motivating and engaging VR rehabilitation systems with low therapist supervision requirements offer potential for use in community rehabilitation or outpatient facilities. This is particularly relevant given that hospital-based and home-based stroke rehabilitation are known to be similarly effective (Teasell et al 2008), and given the interest in home-based stroke rehabilitation (Forster and Young 1990, Young 1994).

The release of the New Zealand Health Strategy Discussion Document (2000) targeted community-based initiatives and supported community stroke rehabilitation. Currently, the New Zealand Clinical Guidelines for Stroke Management (Stroke Foundation of New Zealand and New Zealand Guidelines Group 2010) recommend *interdisciplinary community rehabilitation* and *early supported discharge … to all people with stroke …* (p95). Evidence suggests that approximately 65% of patients are likely to be generally non-adherent to some degree to physiotherapy rehabilitation programmes (Bassett 2003). However, there is evidence to support greater adherence to home-based rehabilitation in stroke compared to clinic-based rehabilitation and improved aptitude of patients to undertake personal activities of daily living with reduced risk of deterioration in ability (Legg et al 2004, Duncan et al 2011).

Evidence exists for the use of bilateral therapy for upper limb hemiplegia, whether synchronous or asynchronous, using assistive devices, or as a motor priming activity (Ausenda and Carnovali 2011; Cauraugh et al 2010; Sampson et al 2012; Stewart et al 2006). As unilateral and bilateral training are similarly effective (van Delden et al 2012) it is possible that future research into matching the best technique for any given stroke patient/pathology may also be important. In a pilot study of 14 participants with chronic-stroke and upper limb hemiplegia, Hijmans et al (2011) found that playing computer games with a bilateral motion-based controller led to a significant gain in Fugl-Meyer Assessment-Upper Extremity (FMA). That study provided bilateral therapy using a modified handlebar to link the arms so that the unaffected arm was able to (self) assist the affected arm. The resulting movement patterns generated were able to be synchronous/mirrored or asynchronous. As this therapy is low-cost with modest space requirements, and is able to be used with a personal computer, it could be used within home environments.

There remains a need to further test if VR systems engage and motivate users sufficiently to achieve an intensity of practice where functional and motor recovery is likely to be positively influenced. In a systematic review of upper limb therapies, Kwakkel et al (2004) concluded that a minimum of 16 hours of therapy in the first six months post-stroke improved activities of daily living outcomes and that engaging in more hours per week was a factor that likely enhanced rate of recovery. We have not found any evidence specifically quantifying engagement and motivation in post-stroke upper limb home therapy though, particularly within the context of computer game activity as therapy. There are limitations with unsupervised or minimally supervised computer facilitated rehabilitation, such as a lack of guidance of motor control facilitation, limited range of actual utilised movement, or lack of controls on compensatory action sequences and compounded movement errors. However, it is worthwhile to establish feasibility in the home environment and to test if users will practice sufficiently without the presence of therapists and their associated extrinsic motivation.

The aim of this study was to investigate the potential of bilateral therapy and computer games played via a motion-based controller as home therapy. We used a case series to assess user engagement in the home environment where there was minimal informal supervision and no therapist supervision for a time period at least longer than six weeks.

METHODS

Participants

Three volunteer participants with chronic, post-stroke upper limb hemiplegia, and who had previously participated in a trial of 10 sessions of bilateral therapy using VR (Hijmans et al 2011), were recruited to participate in home-based therapy for a period of 8 weeks. Screening by a registered physiotherapist was conducted using the following criteria: a) Inclusion: 18 years or over with a confirmed diagnosis of stroke that occurred more than six months prior; limited voluntary movement in their arm affected by stroke; no self-reported orthopaedic or medical conditions or pain preventing them from using the bilateral exercise device comfortably (practically checked); and the ability to provide written informed consent. Exclusion: fixed contractures in the affected upper limb preventing effective and/or safe use of the device; inability to understand the project and its requirements (e.g. due to confirmed diagnosis of dementia or receptive aphasia or per clinical judgement). Information regarding the participant's stroke was obtained directly from the participant.

All participants provided signed informed consent and the study was approved by the University of Otago Human Ethics Committee (09/193).

Study design

A pre-post intervention design was utilised. Participants were assessed (T1), home intervention was performed, and reassessment (T2) occurred in the week following the cessation of intervention.

Outcome measures

a) Primary outcome measures.

(i) Participant diaries of adherence to the intervention: Patient self-reports are suggested as an ideal method of evaluating adherence to home-based physiotherapy (Bassett 2003). To assess patient engagement quantitatively, we used participant diaries to record occurrence and duration of the intervention.

(ii) Intrinsic Motivation Inventory (IMI): A 32 question IMI was used to measure post-intervention motivation (Selfdeterminationtheory.org 2012, McAuley et al 1989). The IMI has validity as a post-intervention measure (McAuley et al 1989) and although it measures several domains, it is the interest/enjoyment domain that primarily assesses intrinsic motivation *per se*. The IMI's questions are face valid and straightforward, having been found to be stable and coherent across a wide range of tasks, conditions and settings (Selfdeterminationtheory.org 2012). The IMI uses a Likert scale that asks the user to rank the statements according to 'how true they are' for them, ranked from 1 (not at all true), 2, 3, 4 (somewhat true), 5, 6, to 7 (very true). An interest/enjoyment score indicating the answers were 4 or more on average would represent positive intrinsic motivation. To check for ego involvement or pressured performance, the perceived choice domain assesses free choice behaviour, allowing correlation with the interest/enjoyment domain. Appendix 1 contains sample questions from each IMI domain.

(iii) Disabilities of Arm, Shoulder and Hand (DASH) questionnaire: To assess participant perceived change in upper limb physical functioning through a range of activities we used the DASH pre- and post-intervention (Hudak et al 1996, Beaton et al 2001). Originally developed for use in musculoskeletal conditions, the DASH is an extensively used, reliable, valid and responsive measure of upper limb physical function (Bot et al 2004).

b) Secondary outcome measures (of body function).

(i) The Fugl-Meyer-Upper Extremity (FMA): The FMA scores motor function out of a total of 66, a higher score indicating better motor function (Fugl-Meyer et al 1975).

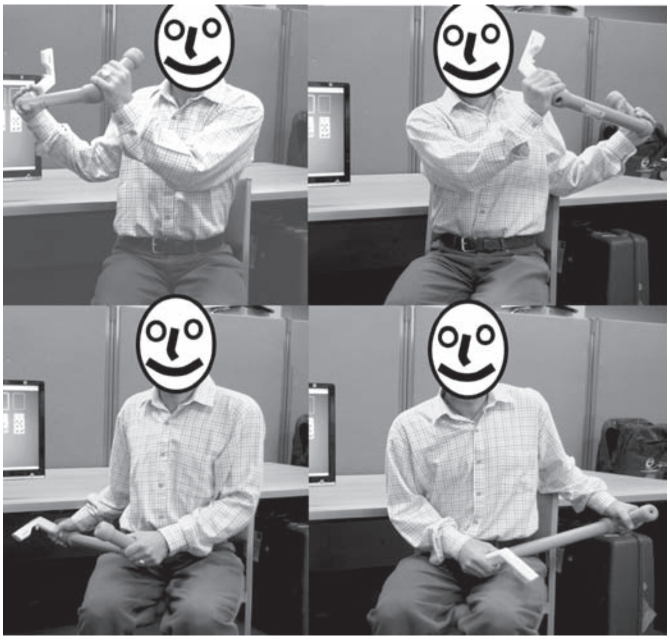
(ii) Motor Assessment Scale (MAS): The MAS (Carr et al 1985) is an eight section assessment of stroke motor function. Each section contains six motor tasks from easiest (score = 1) to most difficult (score = 6), where the best of three attempts is recorded. A zero is recorded if none of the tasks are able to be performed and a six indicates optimal performance in each section. We used the upper limb, hand and advanced hand tasks sections only.

Both the FMA and the MAS are extensively used, reliable and validated functional outcome measures in stroke rehabilitation research (Salter et al 2012).

Hardware

The CyWee Z controller (Cywee Inc., Taiwan), a motion-sensor based game controller similar to the Nintendo Wii remote, was used to control the on-screen cursor of the personal computer-based games. It was incorporated into a handlebar measuring 35-50 cm long (Figure 1). Rotations of the device in the transverse plane produce horizontal mouse cursor translations on the screen, and rotations in the sagittal plane produce vertical mouse cursor translations. A trigger on the Cywee Z acted as a left mouse button.

Figure 1: CyWee Z incorporated into a handlebar showing range of movements required to play the computer games



Software

A suite of computer games with a range of movement, reaction, speed and accuracy challenges were used to promote engaging bilateral movement exercises. The cognitive requirements to play the games were low. The games were either specifically developed, or adapted to provide clear graphics and achievable motor demands, thereby allowing participants to understand and use the games quickly. The following games were used: stationary target hitting games ("Whack a mole") and strategic target hitting games ("Bejewelled" and "Balloon Popping"), moving target hitting games ("Mosquito Swat", "Music Catch" and "ReBounce"), faster sports games ("Air Hockey"), and puzzle games ("Mah-Jong" and "Solitaire"). All games required large cursor movements in both horizontal and vertical directions. Knowledge of results was provided in all games via scores based on time taken, number of successful 'hits', reaction speed and accuracy.

Intervention

To ensure that the systems could be independently operated at home, the participants were orientated, taught and observed sufficiently in the hardware set up, software use and game practice, before the systems were left with them. They then played the games at home over a period of up to 61 days. If the participants were able to use the trigger button of the CyWee Z with their affected hand, the CyWee Z was used in that hand (n=1). If not, the CyWee Z was held in the unaffected hand. If grip strength in the affected hand was insufficient to hold the handlebar, a soft Velcro binder was used to hold the device in their affected hand (n=1). The binder was designed so that it could be independently self-applied. Participants chose when and for how long they played for in each session; however, they were instructed to play for no longer than 90 minutes on any given day. This was a guideline to safeguard against repetitive strain injury whilst still allowing reasonable flexibility with regard to the expression of individual engagement. Participants kept diaries of session duration and days played. Each individual game was played at least once, after which participants were free to choose the proportion of time they spent on any particular game or games. The rationale for allowing the participants to choose what games they played thereafter was to maximise engagement and allow free choice behaviour at least within the limits of the game suite provided. As all the games were designed to promote 'target-hitting', albeit with different visual and play 'themes,' they similarly required participants to exercise through a varied, yet achievable range of arm movements both in direction and reach.

RESULTS

There were no reports of adverse reactions, accidents/injury or prolonged soft tissue irritation from participant use of the intervention.

The participants, two males and one female aged 47 – 65 years, all were more than 18 months post stroke. The dominant side for Participant 3 (P3) was his affected side whereas Participant 1 (P1) and Participant 2 (P2) both were affected on their non-dominant side. Table 1 provides a summary of participant characteristics.

Table 1: Participant characteristics

Participant	P1	P2	P3
Age (years)	65	47	57
Sex	Male	Female	Male
Ethnicity	New Zealand European	New Zealand European	New Zealand European
Affected side	Left	Left	Right
Hand dominance	Right	Right	Right
Time post stroke	18 months	27 months	28 months

Table 2: Primary outcome measures

Participant		P1	P2	P3
Diary:	Number of days intervention used/Total intervention period	44 / 55 days	46 / 58 days	49 / 61 days
Diary:	Average session duration (minutes)	46 mins	35 mins	38 mins
Diary:	Average sessions per week	5.5	5.5	4.5
Diary:	Total hours of intervention	42.3 hrs	33.5 hrs	39.7 hrs
DASH:	Pre intervention : Post intervention (/100)*	23 : 23	50 : 39	40 : 46
IMI	Interest/Enjoyment (/49)	35 (71%)	37 (76%)	22 (45%)
IMI	Perceived Choice (/49)	18 (37%)	19 (39%)	18 (37%)
IMI	Perceived Competence (/42)	32 (76%)	30 (71%)	22 (52%)
IMI	Value/Usefulness (/49)	49 (100%)	49 (100%)	32 (65%)
IMI	Effort/Importance (/35)	23 (66%)	23 (66%)	16 (46%)

*Decrease indicates improvement

Tables 2 and 3 display the results of the primary and secondary outcome measures. These results show that the participants used the device regularly over the period of the home trial and that the intervention was motivating to them. Each participant used the device for 33.5 hours or more over the trial period. Body function change scores were inconclusive

Table 3: Secondary outcome measures

Participant	P1	P2	P3
FMA pre intervention (/66)	57	57	24
FMA post intervention (/66)	57	57	26
MAS pre intervention (/18)	12	10	NT
MAS post intervention (/18)	14	14	NT

NT: Not tested (participant unavailable)

DISCUSSION

All participants demonstrated engagement with the intervention by regularly exercising unsupervised for greater than or equal to 35 minutes per session and for greater than or equal to 4.5 times per week over the 6 week intervention period. This was a positive finding, as it was not clear whether the participants would regularly use the intervention over an extended time period without direct therapist input. A justification for using VR in stroke rehabilitation is the argument that people are motivated by it and thus the desired repetitive practice of upper limb movement to facilitate neuroplasticity is gained (Crosbie et al 2009, Merians et al 2002, Sveistrup 2004). No previous study appears to have investigated this premise in a home-based setting over an extended time. Given that all participants completed greater than 33.5 hours of intervention, they more than fulfilled the required minimum 16 hours of therapy likely to enhance recovery (Kwakkel et al 2004).

P1 and P2 had IMI interest/enjoyment scores of respectively, 71% and 76% and high ratings for value/usefulness. These contrasted with their 37% and 39% perceived choice scores and do temper the IMI's strength in assessing their intrinsic motivation. However, as interest/enjoyment is the key measure of intrinsic motivation, a motivating experience can reasonably be assumed from these scores.

In contrast, P3's interest/enjoyment and perceived choice scores were more correlated than those for P1 and P2, yet lower (45% and 37%). Possibly, P1 and P2 had greater "ego" involvement than P3 and this was reflected in their uncorrelated perceived choice scores (i.e. more self-expectation to perform at a perceived level). There could be many reasons for P3's lower IMI scores, although it is notable that he had been affected by stroke for the longest duration and had hemiplegia on his dominant side. A larger sample and perhaps the use of focussed interviews or other outcome measures is necessary to further explore the associations between various IMI scores and the intervention. Also, comparing outcomes from individual home use of the intervention with individual use within a group (social) setting may help to explore the effects of intrinsic versus extrinsic motivation in stroke upper limb therapy.

DASH scores demonstrated variable perceptions of change in physical symptoms and performance over the intervention period: P1 did not change, P2 improved and P3 declined. These self-reports do not appear to consistently correlate with the change in FMA or MAS scores. P2 gained four MAS points, mainly due to improved hand function, but did not change as measured by the FMA. This perceived hand improvement may have been revealed by the DASH score as a key factor for P2 with the FMA simply being a less sensitive measure of hand function. Interestingly, the overall physical design of the intervention was such that it did not specifically target hand and finger function. Both P1 and P2 had improved during the previous 2.5 week trial (Hijmans et al 2011) and also in the four months between the trial interventions. This perhaps represents an improvement ceiling effect, particularly given that both participants were already relatively higher scorers on the FMA and well into the chronic phase of their stroke recovery. The gains of the previous trial and intervening period may represent the maximising of their recovery potential so that further significant recovery was less likely.

A limitation of this study may arise from the use of the combination of diaries of use and the IMI to investigate the construct of engagement in stroke rehabilitation, i.e. we assumed that 'engagement' is a combination of a psychological state (e.g. involvement, commitment, attachment), and a performance construct (e.g. effort, behaviour). Behavioural engagement implies or infers a motivational process and as such it suffers from a lack of precision, as behaviours are multi-determined. This has largely been identified from research into industrial and organisational psychology (Griffin et al 2008, Macey and Schneider 2008). In the area of rehabilitation and virtual reality platforms it is arguably important that research investigates the psychological factors that operate at the interface, especially when task specificity and intensity of practice are considered important to rehabilitation outcomes. Measuring components of engagement, plus the degree to which participants 'stick to task' is useful. This argument underpinned our use of diaries and the IMI, as the IMI measures domains of interest/enjoyment, value/usefulness, effort/importance, competence and choice. In the home environment of this trial, where professional (extrinsic) therapeutic input was absent, it could be reasonably expected that the IMI/diary results are representative of each participant's (intrinsic) engagement, although this interpretation is cautious. Confounding factors exist though, particularly individual expectations and timing. As the participants were all greater than 18 months post-stroke, it is possible that the 'window of opportunity' for further gains in function had actually significantly waned and been already taken up by the preceding 2.5 week trial (Hijmans et al 2011) and possibly the period between the two studies. This was perhaps counter to the expectations of the participants who thought that they would continue to improve at the same rate and may be relevant to the lack of correlation between the interest/enjoyment and the perceived choice scores obtained from P1 and P2.

To further investigate the effects of the intervention on motor function, this study would have benefitted from utilising the computer system to record real-time kinematics. This requires further development but has potential to reveal motor control variables during game play and may be able to reveal some of the motor control elements of hemiplegic arms during game play plus their change over time (e.g. range of movement, speed and smoothness).

In considering the DASH and FMA results together, an explanation for their contrasting results could be that of a "response shift phenomenon" (Sprangers and Schwartz 1999) where people may, as a result of the research process, re-evaluate the impact their stroke has had on their lives and re-scale their responses. Given these results, caution in interpreting the DASH is warranted and greater sample numbers are required in future home trials.

Active participation in rehabilitation programmes increases the benefit and effectiveness of therapy (Merians et al 2002). Unfortunately stroke rehabilitation, using arguably 'boring' conventional task interfaces, can produce a significant reduction in older adult motivation (Flores et al 2008). This trial shows that it is feasible to combine exercise therapy with computer-aided/VR games at home in a way that appears to interest and motivate users. Further, the diaries revealed that all participants consistently continued their rehabilitation sessions regularly each week for periods of similar duration or greater than that found in rehabilitation clinics, but without any therapist supervision or contact. The main aims of the study, feasibility and engagement, were thus achieved and suggest that the therapy was not 'boring'. Furthermore, because of the regularity of therapeutic game play, it is likely that a suitable intensity of exercise rehabilitation was achieved, although the actual number of repetitions were not recorded. Given that the motor function results were inconclusive though, future testing on a larger sample with less chronic stroke is needed.

The positive IMI results, in particular for interest/enjoyment and value/usefulness, suggest that the participants were successfully motivated by the computer games in combination with the CyWee-Z and handlebar to complete the bilateral therapy exercise regime asked of them. In future studies, pre-assessment of motivation and mood would be useful to initially establish background baselines. Although a range of games was offered, the low perceived choice of the participants may represent that the selection of games did not fully meet their needs or expectations. Two 100% value/usefulness ratings suggest though that the overall system was very positively perceived as being worthy. Overall, it is reasonable to interpret that the intervention motivated and engaged the participants to the extent that further research would be warranted, including comparing the efficacy of the intervention with treatment approaches that provide explicit extrinsic motivation and/or traditional therapy in outpatient or group settings. Without a control, it is not possible to know if the motivation provided by this home trial is truly any more effective than that provided by other interventions.

Although more emphasis in New Zealand is now being placed on primary healthcare and community stroke rehabilitation (Hale 2004), further stroke rehabilitation conducted in the community may add to caregiver stress. Technology, such as described in this paper, has the potential to augment community stroke rehabilitation and possibly lessen the burden on caregivers and community health clinicians, as once installed and set up, it can be used independently or with minimal assistance by many stroke-affected persons. In the future, automated monitoring systems (e.g. telerehabilitation, electronic diaries) could also be combined with the system described in this paper, where remote supervision and quantitative monitoring by clinicians could be provided. Rehabilitation could then be progressed via a more typical client-therapist relationship and provide greater specificity in exercise prescription, yet without the need for a therapist having to be physically present. Remote internet-based monitoring could have benefitted this study by providing richer data, such as actual number of repetitions per session, distance of arm travel, force and direction/accuracy.

When considering home and community based rehabilitation, social rehabilitation atmospheres are preferred by some people (Hale 2004, ILO, UNESCO and WHO 1994). The intervention described in this research could be provided as a component of community-based rehabilitation in group (social) environments, such as fitness gymnasiums or rest homes. It could also be linked into social media networks. These are additional areas for further research using the technology described in this paper.

CONCLUSIONS

This case series demonstrated that bilateral upper limb rehabilitation at home, using computer games played via a motion-based controller, is feasible, engages users for a duration considered necessary for rehabilitation to be effective, and offers potential for home or community-based rehabilitation. Although change in motor function was inconclusive, this study acted as a useful pilot for further research with larger samples into the efficacy of bilateral upper limb stroke rehabilitation, computer facilitated virtual reality and home stroke rehabilitation.

KEY POINTS

- Bilateral upper limb therapy for stroke rehabilitation using a motion-based controller (Cywee-Z) with computer games is feasible in an unsupervised home setting.
- Bilateral upper limb therapy using a motion-based controller and computer games motivates and engages users to exercise for up to 5.5 hours per week over 8 weeks.
- Further research into home therapy systems for upper limb stroke is justified.

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REFERENCES

Ausenda CD, Carnovali M (2011) Transfer of motor skill learning from the healthy hand to the paretic hand in stroke patients: a randomized controlled trial. *European Journal of Physical and Rehabilitation Medicine* 47: 417-425.

Bassett SF (2003) The assessment of patient adherence to physiotherapy rehabilitation. *New Zealand Journal of Physiotherapy* 31: 60-66.

Beaton DE, Davis AM, Hudak P, McConnell S (2001) The DASH (Disabilities of the Arm, Shoulder and Hand) outcome measure: what do we know about it now? *British Journal of Hand Therapy* 6: 109-117.

Bot SD, Terwee CB, van der Windt DA, Bouter LM, Dekker J, de Vet HCW (2004) Clinimetric evaluation of shoulder disability questionnaires: a systematic review of the literature. *Annals of the Rheumatic Diseases* 63: 335-341.

Burdea G, Coiffet P (2003) Virtual Reality Technology (2nd ed.) Hoboken: John Wiley and Sons.

Carr J, Shepherd R, Nordholm L, Lynne D (1985) Investigation of a new motor assessment scale for stroke patients. *Physical Therapy* 65: 175–180.

Cauraugh JH, Lodha N, Naik SK, Summers JJ (2010) Bilateral movement training and stroke motor recovery progress: a structured review and meta-analysis. *Human Movement Science* 29: 853–870.

Crosbie JH, McNeill MD, Burke J, McDonough S (2009) Utilising technology for rehabilitation of the upper limb following stroke: the Ulster experience. *Physical Therapy Reviews* 14: 336–347.

Duncan PW, Sullivan KJ, Behrman AL, Azen SP, Wu SS, Nadeau SE, Dobkin BH, Rose DK, Tilson JK, Cen S, Hayden SK; LEAPS Investigative Team (2011) Body-weight-supported treadmill rehabilitation after stroke. *New England Journal of Medicine* 364: 2026-2036.

Duncan PW, Zorowitz R, Bates B, Choi JY, Glasberg JJ, Graham GD, Katz RC, Lamberty K, Reker D (2005) Management of adult stroke rehabilitation care: a clinical practice guideline. *Stroke* 36: e100-e143.

Flores E, Tobon G, Cavallaro E, Cavallaro FI, Perry JC, Keller T (2008) Improving patient motivation in game development for motor deficit rehabilitation. Proceedings of the 2008 International Conference on Advances in Computer Entertainment Technology. Yokohama, pp 381-384.

Forster A, Young J (1990) The role of community physiotherapy for stroke patients. *Physiotherapy* 76: 495-497.

Fugl-Meyer AR, Jääskö L, Leyman I, Olsson S, Steglind S (1975) The post-stroke hemiplegic patient. 1. A method for evaluation of physical performance. *Scandinavian Journal of Rehabilitation Medicine* 7: 13-31.

Griffin MA, Parker SK, Neal A (2008) Is behavioural engagement a distinct and useful construct? *Industrial and Organizational Psychology* 1: 48-51.

Hale L (2004) Community–based or home-based stroke rehabilitation: confusion or common sense? *New Zealand Journal of Physiotherapy* 32: 131-139.

Henderson A, Korner-Bitensky N, Levin M (2007) Virtual reality in stroke rehabilitation: A systematic review of its effectiveness for upper limb motor recovery. *Topics in Stroke Rehabilitation* 14: 52-61.

Hijmans JM, Hale LA, Satherley JA, McMillan NJ, King MJ (2011) Bilateral upper limb rehabilitation after stroke using a movement based game controller. *Journal of Rehabilitation Research and Development* 48: 1005-1013.

Hudak PL, Amadio PC, Bombardier C (1996) Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand). The Upper Extremity Collaborative Group (UECG). *American Journal of Industrial Medicine* 29: 602-608.

ILO, UNESCO, WHO (1994) Community-based rehabilitation - for and with people with disabilities. Joint position paper, Geneva: United Nations.

Kleim JA, Jones TA (2008) Principles or exercise-dependent neural plasticity: implications for rehabilitation after brain damage. *Journal of Speech, Language, and Hearing Research* 51: S225-239.

Krebs HI, Volpe B, Hogan N (2009) A working model of stroke recovery from rehabilitation robotics practitioners. *Journal of Neuroengineering and Rehabilitation* 6: 6.

Kwakkel G, Kollen BJ, Krebs HI (2008) Effects of robot-assisted therapy on upper limb recovery after stroke: a systematic review. *Neurorehabilitation and Neural Repair* 22: 111-121.

Kwakkel G, Kollen BJ, van der Grond J, Prevo AJ (2003) Probability of regaining dexterity in the flaccid upper limb: impact of severity of paresis and time since onset in acute stroke. *Stroke* 34: 2181–2186.

Kwakkel G, van Peppen R, Wagenaar RC, Wood Dauphinee S, Richards C, Ashburn A, Miller K, Lincoln N, Partridge C, Wellwood I, Langhorne P (2004) Effects of augmented exercise therapy time after stroke: a meta-analysis *Stroke* 35: 2529-2539.

Laver KE, George S, Thomas, S Deutsch JE, Crotty M (2011) Virtual reality for stroke rehabilitation. *Cochrane Database of Systematic Reviews* 9: CD008349.

Legg L, Langhorne P; Outpatient Service Trialists (2004) Rehabilitation therapy services for stroke patients living at home: systematic review of randomised trials. *The Lancet* 363: 352-356.

McAuley E, Duncan T, Tammen VV (1989) Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: a confirmatory factor analysis. *Research Quarterly for Exercise and Sport* 60: 48-58.

Macey WH, Schneider B (2008) The meaning of employee engagement. *Industrial and Organizational Psychology: Perspectives on Science and Practice* 1: 3–30.

Mackay J, Mensah GA (Eds) (2004) The Atlas of Heart Disease and Stroke. Geneva: World Health Organization.

Merians AS, Jack D, Boian R, Tremaine M, Burdea GC, Adamovich SV, Recce M, Poizner H (2002) Virtual reality-augmented rehabilitation for patients following stroke. *Physical Therapy* 82: 898–915.

Nakayama H, Jørgensen HS, Raaschou HO, Olsen TS (1994) Recovery of upper extremity function in stroke patients: the Copenhagen Stroke Study. *Archives of Physical Medicine and Rehabilitation* 75: 394-98.

Richards LG, Stewart KC, Woodbury ML, Senesac C, Cauraugh JH (2008) Movement-dependent stroke recovery: a systematic review and meta-analysis of TMS and fMRI evidence. *Neuropsychologia* 46: 3-11.

Salter K, Jutai J, Zettler L, Moses M, McClure A, Foley N, Teasell R (2011) Module 21 Outcome Measures in Stroke rehabilitation. The Evidence-Based Review of Stroke Rehabilitation (EBRSR) 14th ed. (updated September 2011). http://www.ebrsr.com/uploads/Module-21_outcomes.pdf. (Accessed Sept 19, 2012).

Sampson M, Shau YW, King MJ (2012) Bilateral upper limb trainer with virtual reality for post-stroke rehabilitation: case series report. *Disability and Rehabilitation: Assistive Technology* 7: 55-62.

Saposnik G, Levin M; Outcome Research Canada (SORCan) Working Group (2011) Virtual reality in stroke rehabilitation. A meta-analysis and implications for clinicians. *Stroke* 42: 1380-1386.

Selfdeterminationtheory.org: Intrinsic Motivation Inventory (IMI). University of Rochester. http://www.selfdeterminationtheory.org/questionnaires/10-questionnaires/50 (Accessed September 19, 2012).

Sprangers MA, Schwartz CE (1999) Integrating response shift into health-related quality of life research: a theoretical model. *Social Science and Medicine* 48: 1507–15.

Stewart KC, Cauraugh JH, Summers JJ (2006) Bilateral movement training and stroke rehabilitation: a systematic review and meta-analysis. *Journal of the Neurological Sciences* 244: 89-95.

Stroke Foundation of New Zealand and New Zealand Guidelines Group (2010): Clinical Guidelines for Stroke Management 2010. Wellington: Stroke Foundation of New Zealand. http://www.stroke.org.nz/resources/NZClinicalGuidelinesStrokeManagement2010ActiveContents.pdf (Accessed September 19, 2012).

Sveistrup H (2004) Motor rehabilitation using virtual reality. *Journal of Neuroengineering and Rehabilitation* 1: 10.

Teasell R, Foley N, Bhogal SK, Speechley M (2008) Module 7 Outpatient Stroke rehabilitation. The Evidence-Based Review of Stroke Rehabilitation (EBRSR) 14th ed. (updated June 2011). http://www.ebrsr.com/uploads/Module-7_outpatients_001.pdf. (Accessed Dec 2, 2011).

The New Zealand Health Strategy Discussion Document (2000) Ministry of Health, Wellington, New Zealand.

van Delden AE, Peper CE, Beek PJ, Kwakkel G (2012) Unilateral versus bilateral upper limb exercise therapy after stroke: a systematic review. *Journal of Rehabilitation Medicine* 44: 106-117.

Werner RA, Kessler S (1996) Effectiveness of an intensive outpatient rehabilitation program for postacute stroke patients. *American Journal of Physical Medicine and Rehabilitation* 75: 114-120.

Young J (1994) Is stroke better managed in the community? Community care allows patients to reach their full potential. *British Medical Journal* 309: 1356-1357.

Appendix 1: Sample questions from the 32 question Intrinsic Motivation Inventory

IMI domain	Sample question
Interest/Enjoyment	'I thought this activity was quite enjoyable'
Perceived Choice	'I believe I had some choice about doing this activity'
Effort/Importance	'I put a lot of effort into this'
Perceived Competence	'I think I am pretty good at this activity'
Value/Usefulness	'I think that doing this activity is useful for my arm movement'

The effect of lumbar posture on spinal loading and the function of the erector spinae: implications for exercise and vocational rehabilitation

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ABSTRACT

Lumbar posture is considered to play an important role in low back injury and is of importance during the rehabilitation of clients employed in manual handling occupations. This clinical commentary discusses the implications of lumbar posture on the biomechanical loads placed on the active and passive tissues of the spine, and the contribution the erector spinae play during tasks involving lifting and lowering. There is evidence that lumbar posture can significantly alter the functional role of the erector spinae when lifting and lowering and has implications for the loads that the spine must contend with. This review provides insight into the issues relating to lumbar posture that need to be considered when educating and prescribing exercises for the prevention and management of those individuals involved in manual handling activities.

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Key words: Lumbar spine, posture, erector spinae, spinal loading

INTRODUCTION

Low back pain is one of the most common musculoskeletal disorders treated by physiotherapists. The incidence of low back pain is particularly high in vocations involving manual handling activities, such as lifting and lowering (Magnusson et al 1990, Marras et al 1993). In the past, a number of studies have focused on the benefits of lifting techniques (stoop versus squat) to reduce compressive loading on the lumbar spine. However, the benefits of one technique over another have proved inconclusive (van Dieen et al 1999). More recently, lumbar posture when performing manual handling tasks has been identified as an important factor for the risk of back injury. For example, epidemiological evidence would suggest there is a higher incidence of low back injury associated with those manual handling occupations where workers adopt extreme trunk flexion (Hoogendoorn et al 2000, Punnett et al 1991).

From a biomechanical perspective, lumbar posture during lifting and lowering is important because as the lumbar spine flexes it undergoes a change in configuration that influences the role played by the passive tissues of the spine and the active contribution of the erector spinae. For example, high levels of lumbar flexion have been associated with increased ligamentous and lumbar disc loading, and elevated anterior shear forces (Adams and Dolan 1996, Arjmand et al 2011, McGill 1997, Potvin et al 1991). The lumbar posture adopted during lifting and lowering also influences the morphology, geometry and muscle activation levels of the erector spinae. A change in lumbar curvature can alter fascicle obliquity, lever arm distance, and the length-tension relationships of the erector spinae (McGill et al 2000, Raschke and Chaffin 1996, Singh et al 2011, Tveit et al 1994). These factors influence the ability of erector spinae to resist moments and exert forces (McGill et al 2000, Tveit et al 1994).

From a clinical perspective, understanding the influence lumbar posture has on passive (e.g. discs and ligaments) and active (the erector spinae) subsystems of the spine during lifting and lowering has important implications for postural education and exercise prescription when dealing with clients who are actively involved in manual handling tasks.

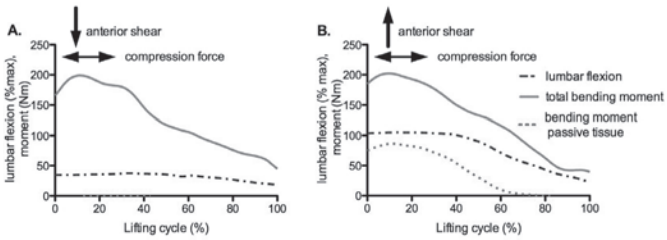
Hence, the aim of this clinical commentary is to discuss some of the biomechanical principles associated with lumbar posture, spinal loading, and erector spinae muscle activity and highlight the implications for the education and the rehabilitation of those involved in manual handling activities.

The effects of lumbar flexion on spinal loading and the risk of injury

The extent to which the lumbar spine is flexed when lifting and lowering is important as it determines the bending moments and anterior shear forces acting on the passive tissues of the spine (Adams and Dolan 1991, Dolan et al 1994a, Potvin et al 1991). Cadaver studies and *in vivo* experiments have found that the bending moment resisted by spinal ligaments and discs (passive tissues) increases exponentially when the spine is flexed beyond 80% of maximal *in vivo* flexion (Adams and Dolan 1991, Dolan et al 1994b).

Figure 1 illustrates this concept and shows that the bending moment on the passive tissues of the spine is high when a person adopts a fully flexed posture (approaching 100% lumbar flexion) at the start of a lift (Figure 1B) compared to someone who adopts a lordotic posture (Figure 1A – approximately 40% flexion). Note that the overall bending moment is similar for both lifters. Equations developed by Adams and Dolan (1991) for estimating the bending moment resisted by the passive tissues of the spine at different lumbar flexion angles indicates that there is virtually no bending moment resisted by the spinal discs and ligaments when the lumbar spine is flexed to 40% (Figure 1A). In contrast, at approximately 100% lumbar flexion the total bending moment resisted by the passive tissues rises to approximately 80 Nm (Figure 1B). Interestingly, the recruitment of passive tissues of the lumbar spine during flexion does not tend to result in a change in spinal compression forces (van Dieen et al 1999). Furthermore, even though the subject in Figure 1B approaches maximal lumbar flexion, the forces that the discs and ligaments must contend with only reach approximately 40% of their elastic limit (Adams and Dolan 1991). However, at the end range of lumbar flexion recruitment of the interspinous ligament complex imposes considerable anterior shear force on the lumbar spine, which has the potential to damage the spine at much lower forces than the spine can withstand in compression (McGill 1997, Potvin et al 1991).

Figure 1. Lumbar flexion (% maximum), total bending moment, and bending moment resisted by the passive tissues of the spine when lifting. Subject A adopts 40% maximum lumbar flexion while subject B adopts near maximum flexion. ↑ indicates increased anterior shear force, ←→ indicates no difference in compression forces between the two postures.



The potential for highly flexed postures to damage the lumbar spine becomes more evident when repetitively lifting and/or lowering. Studies that have simulated repeated loading at end range of lumbar flexion have found an attenuation of the erector spinae reflex response to aid spinal stabilisation and an increase in spinal ligament and intervertebral disc creep (Adams and Dolan 1996, Solomonow 2012, Solomonow et al 1999). Furthermore, when lumbar spine cadaver segments are loaded to simulate a moderate weight being lowered in 45 degrees lumbar flexion, this has been shown to result in spinal tissue damage at an average of 263 repetitive cycles (lumbar flexion-extension), compared to 3257 and 8253 cycles for a spine flexed at 22 and 0 degrees, respectively (Gallagher et al 2005).

The influence of lumbar posture on erector spinae geometry

The major trunk muscles responsible for resisting and controlling the bending moment and anterior shear forces acting on the lumbar spine when lifting and lowering are the erector spinae (Macintosh and Bogduk 1986, McGill et al 1988). In the past, it was assumed that the erector spinae were a single muscle group with similar morphology throughout. However, detailed anatomical studies have differentiated the erector spinae into two distinct subdivisions: 1) the upper erector spinae; and 2) the lumbar erector spinae. Each division has differing geometry in relation to the lumbar spine, which changes with increased lumbar flexion.

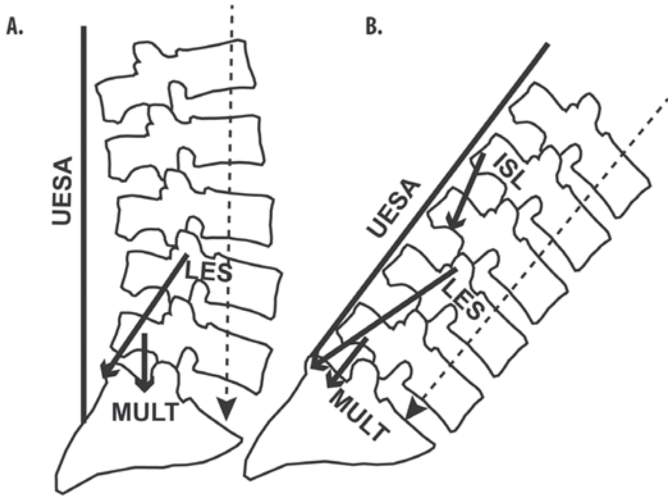
The upper erector spinae consist of the thoracic fibres of iliocostalis lumborum and longissimus thoracis. Thoracic fibres of longissimus and iliocostalis lumborum arise from thoracic spine (Macintosh and Bogduk 1987) and span the entire lumbar spine forming the erector spinae aponeurosis which moves freely over the lumbar erector spinae (Macintosh and Bogduk 1994), connecting to the sacrum and posterior superior iliac spine (Macintosh and Bogduk 1987). In a lordotic posture the upper erector spinae have the greatest moment arm of all the lumbar extensors (Daggfeldt and Thorstensson 2003), which allows them to generate a large extensor moment that resists bending forces produced by forward inclination of the trunk (Macintosh and Bogduk 1987).

The local subgroup of the erector spinae are those muscles whose fascicles originate and insert on the vertebrae of the lumbar spine and pelvis (Bergmark 1989). This group primarily includes the poly segmental muscles – the lumbar components of longissimus and iliocostalis, and multifidus (Bogduk and Twomey 1987), and are often termed the lumbar erector spinae. The lumbar fibres of iliocostalis lumborum and longissimus thoracis are more angulated relative to the vertebral column than the multifidus or the upper erector spinae, with a substantial increase in obliquity towards the L4-L5 region (Macintosh and Bogduk 1991). Therefore, when contracted bilaterally during a symmetrical activity, such as lifting in a lordotic posture, the lumbar fibres of iliocostalis lumborum and longissimus thoracis have the potential to produce large posterior translation and resist anterior shear forces acting on the lumbar spine (Macintosh and Bogduk 1991). The lumbar fibres of iliocostalis lumborum and longissimus have a closer proximity to the spine and, therefore, have less ability to resist bending moments on the spine than the upper erector spinae (Callaghan and McGill 1995). Due to their fascicle obliquity, they are also less able to resist anterior sagittal rotation than multifidus (Macintosh and Bogduk 1991).

Another key muscle of the local erector spinae is multifidus. Multifidus consists of multiple, overlapping layers of fibres (Bojadsen et al 2000). Each fascicle arises from a common tendon attached to the spinous process of individual lumbar vertebrae with fascicles attaching to the mamillary process of the inferior vertebrae, the iliac crest and the sacrum (Macintosh and Bogduk 1986). This fascicle arrangement and segmental innervation gives multifidus the potential to control motion of individual vertebra of the lumbar spine (Bogduk et al 1982). Fascicles of multifidus arise from a common tendon and form a vertical force vector that acts at approximately 90 degrees to the spinous process (Figure 2A). The vector lies behind the axis of sagittal rotation giving multifidus a mechanical advantage when it comes to producing an anti-flexion (extension) moment (Macintosh and Bogduk 1986).

The transition from a lordotic lumbar posture to a fully flexed lumbar spine alters the geometry of the upper erector spinae and lumbar erector spinae, potentially reducing their ability to generate extensor torque and resist anterior shear (Figure 2). Tveit et al (1994), using magnetic resonance imaging, found that at the end range of lumbar flexion the lever arm of the upper erector spinae aponeurosis is reduced by between 10% and 20% throughout the lumbar spine when compared to a lordotic posture. Therefore, it was argued that the reduction in lever arm length would require more muscle force to counteract a given bending moment. Data reported by Macintosh et al (1993) would suggest that the lever arm length of the lumbar erector spinae is also reduced in flexion, but to a lesser extent than the upper erector spinae. However, spinal flexion significantly alters the obliquity of lumbar erector spinae fascicles, which become more closely aligned to the spinal vertebrae resulting in a decrease in the ability to resist anterior shear forces (Macintosh et al 1993, McGill et al 2000, Singh et al 2011). Lumbar flexion has less of an effect on the fascicles of multifidus because of the relatively vertical orientation of the fibres (Macintosh et al 1993).

Figure 2. A schematic diagram showing the changes in the geometry of the upper erector spinae aponeurosis (UESA), lumbar erector spinae (LES) and multifidus (MULT) with a lordotic lumbar posture (A) and maximal flexion (B). In the flexed posture, the erector spinae are elongated, the UESA moves closer to the centre of the disc and the lumbar erector spinae obliquity is reduced. The recruitment of the posterior ligamentous system (including the interspinous ligament (ISL)) in flexion adds to anterior shear. The dotted arrow indicates the compressive axis.



The influence of lumbar posture on trunk extensor torque

Although increased lumbar flexion alters the geometry of the erector spinae in a way that can potentially compromise its ability to generate an extension moment and resist anterior shear, authors who have investigated back extensor torque in static lumbar postures have found increases in torque as the spine becomes more flexed. For example, Roy et al (2003) found that the extensor torque produced in 50 degrees lumbar flexion was twice that produced in a neutral standing (0 degrees) and four-fold that generated in a hyper-lordotic posture (-20 degrees).

This ability to produce considerably greater torque in a flexed lumbar posture has been attributed to increase in the length of the erector spinae (Raschke and Chaffin 1996). As the spine becomes flexed the erector spinae increase muscle fascicle length by an average of 39% of that in a neutral lumbar posture (Macintosh et al 1993). This increased length can increase extensor torque production in two ways. Firstly, an increase in erector spinae length, or stretch, has the potential to store elastic energy within the muscle and provide resistance against bending forces (McGill et al 1994). Secondly, greater torque in a flexed posture may be explained by the length-tension relationship. Raschke and Chaffin (1996) investigated the association between erector spinae length and tension (torque production) using modelling techniques. They found that the length-tension relationship of the erector spinae increases linearly up to 45 degrees of trunk flexion. This suggests that optimal torque production could occur in spinal postures approaching 80% of maximum flexion, independent of passive tissue recruitment.

The length-tension relationship of the erector spinae seems to be supported by studies that have investigated the effect of lumbar posture on the ratio of extensor torque production to levels of erector spinae muscle activation (neuromuscular efficiency ratio) (Roy et al 2003, Tan et al 1993). Evidence has shown that the neuromuscular efficiency ratio increases with increased lumbar flexion at both maximal and submaximal effort (Roy et al 2003, Tan et al 1993). These findings suggest that as the lumbar spine becomes more flexed the length-tension relationship for the erector spinae optimises and less muscle activation is required for a given torque (Granata and Rogers 2007, Roy et al 2003, Tan et al 1993).

The influence of lumbar posture on erector spinae muscle activation and lumbar spine kinematics during dynamic lifting and lowering

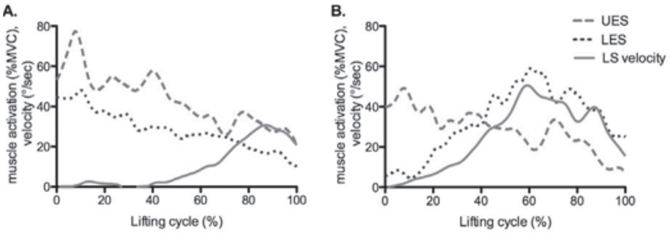
Lifting

An important aspect of transitioning clients into manual handling activities is understanding the relationships between levels of erector spinae muscle activation and lumbar kinematics. These relationships provide an indication of the magnitude of erector spinae recruitment and the types of muscle action (isometric, concentric, and/or eccentric) occurring during lifting and lowering. The lumbar posture (lordotic versus flexed) adopted at the initiation of a lift has a significant bearing on the type and intensity of muscle activity.

Figure 3A shows an example of a person initiating a lift with a lordotic posture (40% of maximal flexion) and the rate of change in lumbosacral angle (angular velocity) and the extent of erector spinae muscle activation. When lifting with a lordotic posture, the upper erector spinae and lumbar erector spinae show similar activation patterns. At the initiation of the lift both the upper erector spinae and lumbar erector spinae activation peak and there is minimal change in lumbar curvature (Figure 3A). This would suggest that the primary action of the erector spinae during the initial stages of a lift is isometric. The advantage of having a relatively stationary lumbar spine during the early stages of lifting is that erector spinae torque production is greater at low levels of lumbar spine velocity (McGill and Norman 1986, Raschke and Chaffin 1996). A relatively static lumbar posture is followed by the dynamic (concentric) phase where the lumbar spine extends rapidly and activation levels of both the upper erector spinae and lumbar erector spinae decrease (Figure 3A). A reduction in activation levels towards the termination of the lift would be expected because as a person lifts their centre of mass and the mass of the load progressively move closer to the to the base of the spine (Keyserling 2000).

When using a flexed lifting posture the upper erector spinae and lumbar erector spinae display quite different activation patterns. Figure 3B shows an example of a person initiating

Figure 3. Upper erector spinae (UES) and lumbar erector spinae (LES) muscle activation expressed as a percentage of maximum voluntary contraction (MVC), and angular velocity of the lumbar spine (LS) during a lift. The subject in Figure 3A uses a lifting technique with minimum of lumbar flexion and in Figure 3B with near maximum lumbar flexion. The lumbar erector spinae of the subject who initiates the lift in fully flexed posture (3B) exhibit the "flexion-relaxation phenomenon", followed by an increase in activation as the angular velocity of the lumbar spine increases.



a lift in maximum lumbar flexion and the changes in lumbar angular velocity and erector spinae muscle activation that occur. During the initiation of the lift, upper erector spinae activation reaches a peak. However, at the same time the lumbar erector spinae is relatively inactive (Figure 3B). The reduction in lumbar erector spinae activity at the end range of lumbar flexion has been termed the flexion-relaxation phenomenon and has been commonly reported in both static postures and during lifting and lowering (Floyd and Silver 1955, Kippers and Parker 1984, Shan et al 2012, Toussaint et al 1995). This phenomenon is thought to occur because the passive tissues of the spine are recruited at end range of lumbar flexion to support the bending moment (Delitto and Rose 1992, Dickey et al 2003, Holmes et al 1992). Throughout the remainder of the lift the activity of the upper erector spinae decreases, whereas lumbar erector spinae activation reaches a peak during the middle of the lift (de Looze et al 1993, Holmes et al 1992, Toussaint et al 1995). This peak in lumbar erector spinae activity corresponds with the point at which lumbar angular velocity is at its highest (Mawston 2010). These activation patterns observed when lifting with a flexed posture may reflect the different functional roles of the upper erector spinae and lumbar erector spinae (Mawston et al 2010). The upper erector spinae is at an increased mechanical advantage when compared to the lumbar erector spinae and is better placed to resist bending moment at the start of the lift (Toussaint et al 1995). However, the morphology of the lumbar erector spinae is better adapted to rapidly change lumbar curvature during the middle to later stages of the lift when bending moments are reduced (Mawston 2010).

Lowering

Whilst a number of studies have focused on lumbar posture during lifting, few have investigated the effects that lumbar posture has on bending moments and erector spinae muscle activation during lowering. De Looze et al (1993) found that lowering an object from an upright position mirrored the moment produced during lifting, with the moment being lowest on the initiation of lowering, and peaking near the end of the lowering cycle, where inertial effects of the decelerating trunk were maximal.

Despite showing a similar peak moment, when compared to lifting, muscle activation of the lumbar erector spinae is substantially less when lowering (de Looze et al 1993, Toussaint et al 1995). The reduced lumbar erector spinae muscle activation during lowering is best explained by the different muscle actions (eccentric and concentric) that occur during the dynamic phases of lowering. For a given force (tension), lower levels of muscle activation are observed during eccentric muscle actions (as occurs during lowering) compared to concentric muscle actions (as occurs during lifting) (de Looze et al 1993, Toussaint et al 1995). At the end stage of lowering, subjects using a flexed lumbar posture will also exhibit the same flexion-relaxation phenomenon of the lumbar erector spinae as that described for lifting in a flexed posture (de Looze et al 1993, Toussaint et al 1995). In contrast, high levels of upper erector spinae activity are evident at the end stages of lowering (Toussaint et al 1995). The different activation patterns of the upper erector spinae and lumbar erector spinae observed during lowering may indicate that in some lumbar postures the upper erector spinae has quite an independent and functionally different role to the lumbar erector spinae.

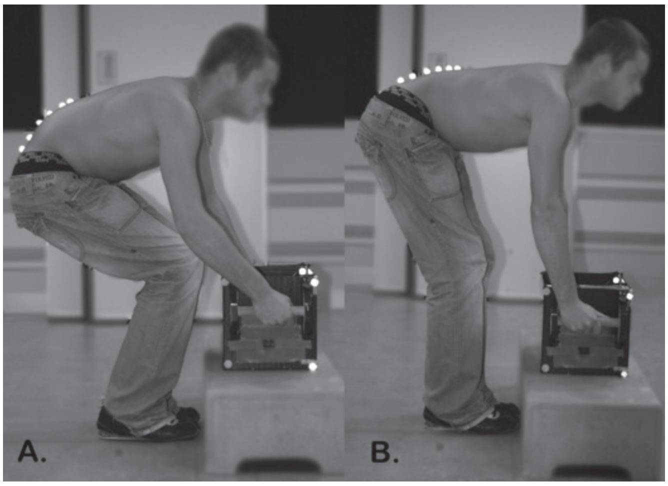
Implications for vocational retraining and exercise rehabilitation

There seems to be strong biomechanical evidence to suggest that end range of lumbar flexion during lifting and lowering should be avoided. It could be argued that this is not just a matter of instructing patients to "bend the knees", as patients who use a bent knee technique can still flex their lumbar spine to maximum range (McGill 1997). An example of this is shown in Figure 4. When the subject is instructed to bend their knees their lumbar spine may flex and approach maximum flexion (Figure 4A), as this becomes their primary mechanism to achieve trunk inclination. In this position their passive tissues would be recruited to bear a large majority of the moment, with an associated increase in the anterior shear force (Dolan et al 1994b, Potvin et al 1991). However, when they adopt a straight knee technique, hip flexion, as opposed to lumbar flexion, can contribute more to trunk inclination (Figure 4B). The lumbar spine in Figure 4B is only flexed to approximately 70% of its maximal range, and the active system (the erector spinae) is the main contributor to resisting the bending moment. Emphasis on maintaining lumbar lordosis during the initiation of a lift will not tend to result in a hyper-lordotic lumbar spine, as even when individuals are instructed to perform a lift in a lordotic posture some degree of lumbar flexion occurs. For example, we have found in a recent study (unpublished data) that when subjects were asked to maximise their lordosis while simulating a box lift close to the ground (30 cm) with the knees flexed at 45 degrees, average lumbar flexion was 40% of their maximal flexion.

The extent of lumbar flexion during exercise rehabilitation is important. The use of machines and exercises that impose large loads towards the end range lumbar flexion should be avoided. For example, exercises, such as bilateral leg press performed incorrectly, can force the lumbar spine into end range of flexion. Lumbar flexion during this exercise can be reduced by performing a unilateral leg press whilst placing the opposite foot on the ground to control lumbo-pelvic rotation (McGill 2007).

The therapist should also take into consideration the different functional roles of the upper erector spinae and lumbar erector spinae when developing rehabilitation programmes. For example, retraining of the lumbar erector spinae should be performed in lumbar postures (avoiding maximal flexion),

Figure 4: A subject lifting a box using bent knee technique with maximal lumbar flexion (A) and with a straight knee technique with reduced lumbar flexion (B).



where lumbar erector spinae are at a mechanical advantage to enable sufficient muscle recruitment without generating high compressive forces on the spine. This mechanical advantage should take into consideration the erector spinae length-tension relationships, which would indicate that retraining in hyper-lordotic postures might not be appropriate. This is further evidenced by the high compressive forces that have been reported during exercises (e.g. prone superman) that hyper-extend the lumbar spine (McGill 2010). It is also important to include exercises that recruit the upper erector spinae, as this muscle group has a more influential role in resisting bending moments when the lumbar erector spinae become mechanically disadvantaged.

The various erector spinae muscle actions (isometric, concentric and eccentric) during lifting and lowering should also be given suitable consideration when designing back exercise programmes. It would seem that at high loads during the initiation of the lift and termination of lowering the erector spinae muscle action is relatively isometric. This highlights the importance of developing adequate motor control to restrict spinal motion during activities where bending moments and inertial forces are large. However, during mid- to late-lifting and the initial and mid-stages of lowering the bending moments are considerable lower, the erector spinae are better placed to exert a force, and muscle activity involves concentric and eccentric actions, respectively. Therefore, the inclusion of exercises that take into consideration erector spinae muscle action when extending (concentric) and flexing (eccentric) the lumbar spine at low loads in moderately flexed postures may also be of benefit when developing training programmes for those individuals involved in lifting and lowering activities.

CONCLUSION

This clinical commentary has highlighted the implications that lumbar posture has on the mechanical loads placed on the active and passive tissues of the spine, and the contribution of the erector spinae during tasks involving lifting and lowering. Whilst it is appreciated that a number of other factors (e.g. contribution of other muscles, load and environmental factors) can influence spinal loading during manual handling tasks performed in or outside the workplace, it is hoped that this review will provide clinicians with an insight into the effective implementation of educational and exercise prescription programmes for the prevention and management of low back injury.

KEY POINTS

- End range of lumbar flexion should be avoided as it recruits the passive tissues of the lumbar spine and alters erector spinae geometry. This serves to increase the bending moment on the spine and decrease the spine's ability to resist anterior shear forces.
- Exercise programmes should target the different functional roles of the upper and lumbar erector spinae during lifting and lowering, and incorporate static and dynamic muscle training appropriate for controlling lumbar posture.

ADDRESS FOR CORRESPONDENCE

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REFERENCES

Adams MA and Dolan P (1991) A technique for quantifying the bending moment acting on the lumbar spine in vivo. *Journal of Biomechanics* 24: 117-126.

Adams MA and Dolan P (1996) Time-dependent changes in the lumbar spine's resistance to bending. *Clinical Biomechanics* 11: 194-200.

Arjmand N, Plamondon A, Shirazi-Adl A, Lariviére C and Parnianpour M (2011) Predictive equations to estimate spinal loads in symmetric lifting tasks. *Journal of Biomechanics* 44: 84-91.

Bergmark A (1989) Stability of the lumbar spine. A study in mechanical engineering. *Acta Orthopaedica Scandinavica. Supplementum* 230: 1-54.

Bogduk N and Twomey LT (1987) *Clinical anatomy of the lumbar spine* (First edn). New York: Churchill Livingstone.

Bogduk N, Wilson AS and Tynan W (1982) The human lumbar dorsal rami. *Journal of Anatomy* 134: 383-397.

Bojadsen TW, Silva ES, Rodrigues AJ and Amadio AC (2000) Comparative study of Mm. Multifidi in lumbar and thoracic spine. *Journal of Electromyography and Kinesiology* 10: 143-149.

Callaghan JP and McGill SM (1995) Muscle activity and low back loads under external shear and compressive loading. *Spine* 20: 992-998.

Daggfeldt K and Thorstensson A (2003) The mechanics of back-extensor torque production about the lumbar spine. *Journal of Biomechanics* 36: 815-825.

de Looze MP, Toussaint HM, van Dieen JH and Kemper HC (1993) Joint moments and muscle activity in the lower extremities and lower back in lifting and lowering tasks. *Journal of Biomechanics* 26: 1067-1076.

Delitto RS and Rose SJ (1992) An electromyographic analysis of two techniques for squat lifting and lowering. *Physical Therapy* 72: 438-448.

Dickey JP, McNorton S and Potvin JR (2003) Repeated spinal flexion modulates the flexion-relaxation phenomenon. *Clinical Biomechanics* 18: 783-789.

Dolan P, Earley M and Adams MA (1994a) Bending and compressive stresses acting on the lumbar spine during lifting activities. *Journal of Biomechanics* 27: 1237-1248.

Dolan P, Mannion AF and Adams MA (1994b) Passive tissues help the back muscles to generate extensor moments during lifting. *Journal of Biomechanics* 27: 1077-1085.

Floyd WF and Silver PH (1955) The function of the erectores spinae muscles in certain movements and postures in man. *Journal of Physiology* 129: 184-203.

Gallagher S, Marras WS, Litsky AS and Burr D (2005) Torso flexion loads and the fatigue failure of human lumbosacral motion segments. *Spine* 30: 2265-2273.

Granata KP and Rogers E (2007) Torso flexion modulates stiffness and reflex response. *Journal of Electromyography and Kinesiology* 17: 384-392.

Holmes JA, Damaser MS and Lehman SL (1992) Erector spinae activation and movement dynamics about the lumbar spine in lordotic and kyphotic squat-lifting. *Spine* 17: 327-334.

Hoogendoorn WE, Bongers PM, de Vet HC, Douwes M, Koes BW, Miedema MC, Ariens GA and Bouter LM (2000) Flexion and rotation of the trunk and lifting at work are risk factors for low back pain: results of a prospective cohort study. *Spine* 25: 3087-3092.

Keyserling WM (2000) Workplace risk factors and occupational musculoskeletal disorders, Part 1: A review of biomechanical and psychophysical research on risk factors associated with low-back pain. *American Industrial Hygiene Association Journal* 61: 39-50.

Kippers V and Parker AW (1984) Posture related to myoelectric silence of erectores spinae during trunk flexion. *Spine* 9: 740-745.

Macintosh JE and Bogduk N (1986) The biomechanics of the lumbar multifidus. *Clinical Biomechanics* 1: 205-213.

Macintosh JE and Bogduk N (1987) The morphology of the lumbar erector spinae. *Spine* 12: 658-668.

Macintosh JE and Bogduk N (1991) The attachments of the lumbar erector spinae. *Spine* 16: 783-792.

Macintosh JE and Bogduk N (1994) The anatomy and function of the lumbar back muscles. In Boyling JD, Palastanga N, Jull GA, Lee DG (Eds) Grieve's Modern Manual Therapy Edn). New York: Churchill Livingstone, pp 189-209.

Macintosh JE, Bogduk N and Pearcy MJ (1993) The effects of flexion on the geometry and actions of the lumbar erector spinae. *Spine* 18: 884-893.

Magnusson M, Granqvist M, Jonson R, Lindell V, Lundberg U, Wallin L and Hansson T (1990) The loads on the lumbar spine during work at an assembly line. The risks for fatigue injuries of vertebral bodies. *Spine* 15: 774-779.

Marras WS, Lavender SA, Leurgans SE, Rajulu SL, Allread WG, Fathallah FA and Ferguson SA (1993) The role of dynamic three-dimensional trunk motion in occupationally-related low back disorders. The effects of workplace factors, trunk position, and trunk motion characteristics on risk of injury. *Spine* 18: 617-628.

Mawston G (2010) *Neuromuscular and postural responses to sudden loading and high frequency lifting: effects of posture and fatigue*. PhD Thesis. AUT University, pp 236.

Mawston GA, McNair PJ and Boocock MG (2010) Lumbar spine kinematics and trunk muscle activation in stoop and squat lifters during repetitive lifting and lowering to fatigue. Proceedings of the ISEK 2010: The XVIII congress of International Society of Electrophysiology and Kinesiology, Aalborg, Denmark,

McGill S (1997) The biomechanics of low back injury: implications on current practice in industry and the clinic. *Journal of Biomechanics* 30: 465-475.

McGill S (2007) *Low back disorders: evidence-based prevention and rehabilitation.* (Second edn). Champaign, IL.: Human Kinetics.

McGill S (2010) Core training: Evidence translating to better performance and injury prevention. *Strength and Conditioning Journal* 32: 33-46.

McGill S, Hughson RL and Parks K (2000) Changes in lumbar lordosis modify the role of the extensor muscles. *Clinical Biomechanics* 15: 777-780.

McGill S and Norman RW (1986) Partitioning of the L4-L5 dynamic moment into disc, ligamentous, and muscular components during lifting. *Spine* 11: 666-678.

McGill S, Patt N and Norman RW (1988) Measurement of the trunk musculature of active males using CT scan radiography: implications for force and moment generating capacity about the L4/L5 joint. *Journal of Biomechanics* 21: 329-341.

McGill S, Seguin J and Bennett G (1994) Passive stiffness of the lumbar torso in flexion, extension, lateral bending, and axial rotation. Effect of belt wearing and breath holding. *Spine* 19: 696-704.

Potvin JR, McGill SM and Norman RW (1991) Trunk muscle and lumbar ligament contributions to dynamic lifts with varying degrees of trunk flexion. *Spine* 16: 1099-1107.

Punnett L, Fine LJ, Keyserling WM, Herrin GD and Chaffin DB (1991) Back disorders and nonneutral trunk postures of automobile assembly workers. *Scandinavian Journal of Work, Environment and Health* 17: 337-346.

Raschke U and Chaffin DB (1996) Support for a linear length-tension relation of the torso extensor muscles: an investigation of the length and velocity EMG-force relationships. *Journal of Biomechanics* 29: 1597-1604.

Roy AL, Keller TS and Colloca CJ (2003) Posture-dependent trunk extensor EMG activity during maximum isometrics exertions in normal male and female subjects. *Journal of Electromyography and Kinesiology* 13: 469-476.

Shan X, Zhang Y, Zhang T, Chen Z and Wei Y (2012) Flexion relaxation of erector spinae response to spinal shrinkage. *Journal of Electromyography and Kinesiology* 22: 370-375.

Singh DKA, Bailey M and Lee RYW (2011) Ageing modifies the fibre angle and biomechanical function of the lumbar extensor muscles. *Clinical Biomechanics* 26: 543-547.

Solomonow M (2012) Neuromuscular manifestations of viscoelastic tissue degradation following high and low risk repetitive lumbar flexion. *Journal of Electromyography and Kinesiology* 22: 155-175.

Solomonow M, Zhou BH, Baratta RV, Lu Y and Harris M (1999) Biomechanics of increased exposure to lumbar injury caused by cyclic loading: Part 1. Loss of reflexive muscular stabilization. *Spine* 24: 2426-2434.

Tan JC, Parnianpour M, Nordin M, Hofer H and Willems B (1993) Isometric maximal and submaximal trunk extension at different flexed positions in standing. Triaxial torque output and EMG. *Spine* 18: 2480-2490.

Toussaint HM, de Winter AF, de Haas Y, de Looze MP, Van Dieen JH and Kingma I (1995) Flexion relaxation during lifting: implications for torque production by muscle activity and tissue strain at the lumbo-sacral joint. *Journal of Biomechanics* 28: 199-210.

Tveit P, Daggfeldt K, Hetland S and Thorstensson A (1994) Erector spinae lever arm length variations with changes in spinal curvature. *Spine* 19: 199-204.

van Dieen JH, Hoozemans MJ and Toussaint HM (1999) Stoop or squat: a review of biomechanical studies on lifting technique. *Clinical Biomechanics* 14: 685-696.

Can functional postural exercise improve performance in the cranio-cervical flexion test? – A preliminary study

Beer A, Treleaven J, Jull G (2012) Can functional postural exercise improve performance in the cranio-cervical flexion test? – A preliminary study. Manual Therapy 17: 219-224. (Abstract prepared by Ricky Bell)

Objective

To assess the physiological effectiveness of deep cervical flexor (DCF) strengthening exercises performed in a functional upright posture.

Methods

A convenience sample of 20 participants aged between 18 and 54 years (10 male, 10 female; mean age 29.3 SD 11.4 years) with persistent neck pain and impaired muscle activity in the cranio-cervical flexion test (CCFT) were recruited. The CCFT involves a five stage upper cervical flexion procedure in a supine crook-lying position of incremental difficulty using a pressure biofeedback unit. Participants were randomly assigned into two groups: exercise intervention group (n=10) or a control non-exercise group (n=10). Over a two week intervention period the exercise group performed an upper cervical flexion manoeuvre in an upright posture with a neutral lumbo-pelvic position. The primary outcome measure was the difference in sternocleidomastoid (SCM) normalised surface electromyographic (EMG) amplitude over the five stages of the CCFT. Other measurements included the Neck Disability Index (NDI), the Visual Analogue Scale (VAS) as a report of pain and Patient Specific Functional Scale (PSFS) to assess function.

Results

Both groups were homogenous at baseline with respect to age, length of history of neck pain, VAS, NDI, PSFS scores and mean SCM EMG amplitudes for each stage of the CCFT. There were no significant differences for NDI, VAS or PSFS scores between the groups pre- to post-intervention although SCM EMG amplitudes were significantly less in the exercise group for all stages of the CCFT with the exception of the first stage (22 mmHg). Intra-group mean values in SCM EMG amplitudes of the CCFT were significantly less post-intervention at the first and third stages of the CCFT; 22 mmHg ($p = 0.043$) and 26 mmHg ($p = 0.003$) for the intervention group; no such differences were evident at any stage of the CCFT for the control group.

Conclusions

Training with an upper cervical flexion neck lengthening manoeuvre in a more functional upright position improved the cervical flexor motor patterning in the CCFT, measured as a decrease in SCM activity. Importantly, the results necessitate further investigation and provide justification for a larger study with direct measures of both SCM and DCF muscles using more invasive measures of muscle activity.

Commentary

Current literature suggests that training of the DCF muscles is an important component for the rehabilitation of neck pain disorders (Jull 2008). Traditionally DCF strengthening exercises are performed in a supine crook-lying position using a motor relearning approach using low load exercises (Jull 2008). From a practical viewpoint, training in supine limits the number of repetitions that a patient can practice in a day and there is mixed evidence demonstrating the transfer of improvement in DCF muscle performance to functional postures or activities with such training (Falla et al 2008). Additionally, for effective motor relearning to occur repetition is paramount. Hence, as evident by the good compliance rates by participants in this study, an exercise that is easily transferable into a person's daily activities is desirable.

Reduced activation of the DCF muscles has previously been demonstrated to be associated with increased activation of the superficial flexor muscles in studies using the CCFT in patients with persisting dysfunction and neck pain (Falla et al 2004, Jull et al 2009). Content validity issues aside, the inverse relationship that exists between SCM and DCF activity (i.e. with less SCM activity there is a corresponding increase in DCF) makes surface SCM EMG activity the measurement of choice for investigative research in this area (Falla et al 2004, Jull et al 2009). While some inferences can be made through deductive logic there are also face validity issues with the underlying premise that changes in DCF muscle function are a cause or effect of persisting pain states in the cervical spine. It is worth mentioning that it was not the purpose of this research to correlate DCF muscle dysfunction and neck pain, rather it was a necessary first step towards establishing the need for further enquiry into the efficacy of performing DCF strengthening exercises in a more functional upright posture.

This esteemed group of authors demonstrated that a more functional method of training the DCF in an upright position elicited favourable changes in SCM EMG amplitudes at the first and third stages of the CCFT. Although statistically significant changes were not demonstrated across all five incremental levels, the conclusion was made that DCF muscle retraining in a more functional upright postural position was provisionally useful. While this research may not have been sufficiently powered and its findings were not categorical, it is noteworthy that it was a pilot study used to determine if further high cost and invasive research was justified. In that regard, it was a suitable vehicle for that purpose and of sound methodological quality.

It is yet to be established conclusively that synergistic activity/inactivity of neck musculature (deep vs. superficial) is a predisposition for persisting cervical pain states, as is the case with other presentations (e.g. abdominal muscles and multifidus in those with low back pain). The authors readily acknowledge that focussing on a single muscle group is both inadequate and unrealistic in a clinical context given the multitude of contributing factors and where a multimodal intervention approach is often indicated. Nonetheless, based on current knowledge the clinical relevance of this work is significant especially if continuing research can demonstrate the effectiveness of DCF strengthening in a more functional position. This may eventually be of benefit to a large population of patients who present with persisting neck pain.

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REFERENCES

Falla D, Jull G, Hodges P (2008) Training the cervical muscles with prescribed motor tasks does not change muscle activation during a functional activity. *Manual Therapy* 13: 507-512.

Falla DL, Jull GA, Hodges PW (2004) Patients with neck pain demonstrate reduced electromyographic activity of the deep cervical flexor muscles during performance of the craniocervical flexion test. *Spine* 29: 2108-2114.

Jull GA (2008) Whiplash, Headache, and Neck Pain: Research-based Directions for Physical Therapies. Edinburgh: Churchill Livingstone/Elsevier.

Jull GA, Falla D, Vicenzino B, Hodges PW (2009) The effect of therapeutic exercise on activation of the deep cervical flexor muscles in people with chronic neck pain. *Manual Therapy* 14: 696-701.

Kinetic Control. The Management of Uncontrolled Movement

Mark Comerford, Sarah Mottram 2012. Elsevier Australia. ISBN number 978-0-7295-3907-4; 532 pages. Soft cover.

Mark Comerford and Sarah Mottram are the founders of the Kinetic Control approach which is based on the premise that 'uncontrolled movement' or 'movement faults' can predispose people to musculoskeletal pain and disability. Their research has been widely published in the musculoskeletal literature and this is their first book. The aim of the text is to provide a clinical approach to the assessment and correction of movement faults.

The terminology used in this book is specific to kinetic control. However a lack of prior knowledge of the terms will not prevent clinicians accessing the concepts because the notion of movement faults is consistent with other approaches familiar to physiotherapists (e.g. muscle imbalance, motor control dysfunction, deep muscles providing spinal stability etc). This book is well referenced and acknowledges the influences of leading authors in the development and support of the main concepts.

The book is divided into two sections with section one (chapters 1-4), introducing the concept of 'uncontrolled movement' along with methods for their identification and classification. Chapter two provides an overview of muscle function and physiology with a particular focus on the foundation knowledge required for the sections to follow. Chapter three covers the assessment and classification of 'uncontrolled movement' where the authors introduce an assessment template which helps the clinicians describe and record quality of movement. They term this the 'motor control rating system' and it is supported by a simple tick box assessment form which is completed as the clinician evaluates the ability of the patient to correctly and efficiently perform a specific movement. Each of the test movements has its own assessment form with details specific to the anatomical area. Chapter four provides a detailed approach to retraining strategies for movement faults. Complexities such as chronic pain, motivation and compliance are also discussed.

This first section is very comprehensive and the detailed text is enhanced by the frequent use of easily understood diagrams and tables. A particularly useful image describes where Kinetic Control fits amongst other musculoskeletal approaches so that clinicians can understand the relationship between Kinetic Control and other physiotherapy techniques and alternate therapies.

The second section is divided into five chapters under the following headings - the lumbopelvic region, the cervical spine, the thoracic spine, the shoulder girdle and the hip region. Each contains a brief introduction to the anatomical areas and then an elaboration on how to make a diagnosis of the commonly presenting dysfunctional movement pattern. The authors then present a vast range of specific motor control tests (eighty two in total) accompanied by photographs and the appropriate 'motor control rating' assessment form. While well constructed and sequential this can feel heavy going if you are trying to read it from cover to cover. However, having stated this, the detail provides the clinician with an excellent reference for repeated access over time. A further enhancement of this section would be an accompanying CD ROM to demonstrate the dynamic qualities of the assessment methods and treatment regime. The addition of case studies would also be a helpful learning tool to assist readers to understand and apply their knowledge in the clinical setting. (e.g. treatment progressions, integration into functional activities, return to sport/ work etc).

Overall the authors achieve their aim by providing an extremely detailed text which is well thought out, assimilates other relevant research into an assessment and treatment approach with high face validity in the area of movement dysfunction and management of musculoskeletal pain. The accessibility, sequential layout and logical development of complex concepts to a relatively advanced level provides enough for this book to be a valuable reference and clinical guide for students, experienced clinicians and teachers alike.

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Cortical Visual Impairment – An Approach to Assessment and Intervention

Christine Roman-Lantzy 2010 (Re-print). AFB Press New York. ISBN – 13 978-0-89128-829-9, ISBN – 10 0-89128-829-5. Softcover 185 pages. RRP:$93.99

Dr Christine Roman-Lantzy's guide to assessment and intervention for children with Cortical Visual Impairment (CVI) is a resource for a range of health professions including Speech and language therapy, Occupational Therapy and Physiotherapy.

Roman's background includes working as a teacher for visually impaired students in public, private schools, home and hospital settings. This book offers a structured approach to guide the professional working with children with CVI. The book is well set out in six chapters and includes a number of resources which professionals are able to use.

Chapter one offers an historical overview and clear definition of CVI. This chapter clearly highlights to the reader the critical period in a child's visual development and the importance of early detection of CVI.

Chapter two discusses the causes of CVI, Roman provides examples from children she has worked with to link the information.

Chapter three presents the ten visual behaviours most commonly associated with CVI. Roman states that "Generally the greater severity of CVI the greater number of behaviours will be evident." However she reassures that these behaviours can change and improve with appropriate intervention.

Within chapter four Roman offers a thoughtful and family centred approach highlighting the parents as experts in providing information to therapists / and or teachers regarding their child's visual behaviours. The chapter offers personal accounts from parents caring for children with CVI which are thought provoking and highlights the need for therapists / teachers to have knowledge / understanding of CVI. Within this chapter there is basic information regarding interviewing families and listening to concerns, this information would be valuable for undergraduate therapists working in client centred practice.

Chapter five discusses the author's approach to functional visual assessments based on a framework called the CVI range. This is a two part assessment protocol that Roman has developed to establish the level of visual functioning. The initial phase of the assessment considers the extent to which the child is affected by each individual characteristic of CVI. The second phase focuses upon the extent each behaviour impacts upon the child's ability to use functional vision. The author's method for assessment is thorough and systematic, information is gathered by: interviews (i.e. with parents / teachers), observations and direct evaluation. There are case studies which are helpful in illustrating the application of the CVI range. There is a CVI resolution chart which offers a summary of the data obtained from the assessment process.

Chapter six considers in detail program planning and intervention. Roman details phases I to III of CVI, this indicates where the child is in terms of CVI resolution and offers information regarding goal setting in each phase. The three phases range from 'building visual behaviour' to the 'resolution of remaining CVI characteristics'. Useful examples are given to assist the team to plan and implement a program which can be incorporated in everyday activities with appropriate CVI adaptations. Roman suggests that in order for intervention to be most effective it should be within the child's daily routine,

As an Occupational Therapist working within a regional brain injury service I would find this book a useful reference. The resources and assessment tools would require further study. This book highlight's the need for professionals working with children with brain injury to be aware of the features of CVI so this can be identified early allowing thorough assessment and intervention within a family centred approach.

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Improving Hand Function in Children with Cerebral Palsy: theory, evidence and interventionAnn-Christin Eliasson &Patricia A. Burtner(eds)

2008 Mac Keith Press 30 Furnival Street, London EC4A 1J. IBSN: 978-1-898683-53-7. Hardcover; pages 442. RRP: $ 164.00

This book is a continuation of the well-respected Clinics in Developmental Medicine series. It has been developed to provide a comprehensive review of the upper extremity neuro-pathophysiology, development of hand function and an overview of contemporary intervention for children with cerebral palsy.

The text is divided into 26 chapters written by a variety of academic and clinical professionals, primarily within the field of occupational therapy from Australasia, North America and Europe. Each chapter is well researched, using credible literature to support presented information.

The first half of the book reviews the basics; neuroscience, upper extremity anatomy, spasticity, neurodevelopment and motor learning. These chapters provide a good overview for most paediatric physiotherapists but would also be beneficial for recently graduated occupational therapists working in paediatrics. Although the book is focused on therapists treating children with the diagnosis of cerebral palsy, the information in these initial chapters can be translated to other neurological impairments. They have included useful diagrams and pictures that help clarify information presented, especially beneficial within the neuroscience chapters.

The end of the book focuses on current medical management, therapy assessments and interventions. The therapy sections are primarily occupational therapy focused, but neurodevelopmental therapist and paediatric physiotherapist could incorporate some of the principles and tools discussed, to their clinical practice.

Unfortunately, the chapters dedicated to medical intervention, such as surgical correction and Botulinum Toxin A injections are aimed at novice therapists and families. Although these chapters provide a respectable summary, they could have included new advancements within this area. I recognise that these interventions may not be available in all centres but it is important for therapists to be aware of all potential treatments on offer.

The therapy based chapters are directed towards the contemporary practicing philosophy of family and child goal focused intervention and the child's ability to participate, rather than the traditional impairment based treatments.

In particular, chapter 18 is dedicated to goal setting and highlights tools that can be used across all disciplines. At the end of the chapter they present case studies to demonstrate their application.

Chapter 12 is designed to facilitate the therapist to evaluate assessment tools. With the ongoing addition of new assessments and the emphasis of providing evidence to service providers, it is important for therapists to be able to choose the most appropriate assessment. Although the chapter is dedicated to upper limb assessments, key principles can be applied to assessments in other fields.

In summary, the majority of the information in this book is relevant to paediatric physiotherapy practice and would be especially useful to physiotherapists working in isolation with children with cerebral palsy.

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Acupuncture

Whitehurst DGT, Bryan S, Hay EM, Thomas E, Young J and Foster NE (2011) Cost-effectiveness of acupuncture care as an adjunct to exercise-based physical therapy for osteoarthritis of the knee. *Physical Therapy* 91:630-641 http://ptjournal.apta.org/content/91/5/630.full.pdf

Arthritis

Brosseau L et al (2011) Ottawa Panel evidence-based clinical practice guidelines for the management of osteoarthritis in adults who are obese or overweight. *Physical Therapy* 91:843-861 http://ptjournal.apta.org/content/91/6/843.full.pdf+html

Cardiovascular

Brunelle CL and Mulgrew JA (2011) Exercise for intermittent claudication. *Physical Therapy* 91:997-1002 http://ptjournal.apta.org/content/91/7/997.full.pdf+html

Neurology

Harvey LA, Ristev D, Hossain MS, Hossain MA, Bowden JL, Boswell-Ruys CL, Hossain MM and Ben M (2011) Training unsupported sitting does not improve ability to sit in people with recently acquired paraplegia: a randomised trial. *Journal of Physiotherapy* 57:83 http://ajp.physiotherapy.asn.au/AJP/vol_57/2/JPhysiohterv57i2Harvey.pdf

Yardley L, Barker F, Muller I, Turner D, Kirby S, Mullee M, Morris A and Little P (2012) Clinical and cost effectiveness of booklet based vestibular rehabilitation for chronic dizziness in primary care: single blind, parallel group, pragmatic, randomised controlled trial. *BMJ* 6:344 http://www.bmj.com/content/344/bmj.e2237.pdf%2Bhtml

Older Adult

Landers MR, Durand C, Powell DS, Dibble LE and Young DL (2011) Development of a scale to assess avoidance behavior due to a fear of falling: The Fear of Falling Avoidance Behavior Questionnaire. *Physical Therapy* 91:1253-1265 http://ptjournal.apta.org/content/91/8/1253.full.pdf+html

Orthopaedics

Vissers MM, Bussmann JB, Verhaar JAN, Arends LR, Furlan AD and Reijman M (2011) Recovery of physical functioning after total hip arthroplasty: systematic review and meta-analysis of the literature. *Physical Therapy* 91:615-629 http://ptjournal.apta.org/content/91/5/615.full.pdf+html

Paediatric

Blauw-Hospers CH, Dirks T, Hulshof LJ, Bos AF and Hadders-Algra M (2011) Pediatric physical therapy in infancy: from nightmare to dream? A two-arm randomized trial. *Physical Therapy* 91:1323-1338 http://ptjournal.apta.org/content/91/9/1323.full.pdf+html

Professional issues

Duncan EA and Murray J (2012) The barriers and facilitators to routine outcome measurement by allied health professionals in practice: a systematic review. *BMC Health Services Research* 12:96-105.http://www.biomedcentral.com/content/pdf/1472-6963-12-96.pdf

McEvoy MP, Williams MT, Olds TS, Lewis LK and Petkov J (2011) Evidence-based practice profiles of physiotherapists transitioning into the workforce: a study of two cohorts. *BMC Medical Education* 11:100-109 http://www.biomedcentral.com/content/pdf/1472-6920-11-100.pdf

Psychological factors

Linton SJ and Shaw WS (2011) Impact of psychological factors in the experience of pain. *Physical Therapy* 91:700-711 http://ptjournal.apta.org/content/91/5/700.full.pdf+html

Hill JC and Fritz JM (2011) Psychosocial Influences on low back pain, disability, and response to treatment. *Physical Therapy* 91:712-721 http://ptjournal.apta.org/content/91/5/712.full.pdf+html

Fritz JM, Beneciuk JM and George SZ (2011) Relationship between categorization with the StarT back screening tool and prognosis for people receiving physical therapy for low back pain. *Physical Therapy* 91:722-732 http://ptjournal.apta.org/content/91/5/722.full.pdf+html

Nicholas MK, Linton SJ, Watson PJ, Main CJ and the "Decade of the Flags" Working Group (2011) Early identification and management of psychological risk factors ("Yellow Flags") in patients with low back pain: a reappraisal. *Physical Therapy* 91:737-753 http://ptjournal.apta.org/content/91/5/737.full.pdf+html

Nicholas MK and George SZ (2011) Psychologically informed interventions for low back pain: an update for physical therapists. *Physical Therapy* 91:765-776 http://ptjournal.apta.org/content/91/5/765.full.pdf+html

Overmeer T, Boersma K, Denison E and Linton SJ (2011) Does teaching physical therapists to deliver a biopsychosocial treatment program result in better patient outcomes? A randomized controlled trial. *Physical Therapy* 91:804-819 http://ptjournal.apta.org/content/91/5/804.full.pdf+html

Shaw WS, Main CJ and Johnston V (2011) Addressing occupational factors in the management of low back pain: implications for physical therapist practice. *Physical Therapy* 91:777-789 http://ptjournal.apta.org/content/91/5/777.full.pdf+html

Sports

Kippelen P, Fitch KD, Anderson SD, Bougault V, Boulet LP, Rundell KW, Sue-Chu M and McKenzie DC (2012) Respiratory health of elite athletes - preventing airway injury: a critical review. *British Journal Sports Medicine* 46:471-476. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3371227/pdf/bjsm-46-7-0471.pdf

The guidelines for submission of papers to the New Zealand Journal of Physiotherapy have been revised. The new guidelines and a submission checklist are provided below and are also available on the Physiotherapy New Zealand website (http://www.physiotherapy.org.nz) – Resources & Publications – New Zealand Journal of Physiotherapy.

The *New Zealand Journal of Physiotherapy* is the official academic journal of Physiotherapy New Zealand Inc. The Journal invites authors to contribute papers relevant to any aspect of the science and practice of physiotherapy. Manuscripts are reviewed under the following categories:

a) Research Report

Research reports include original research using quantitative or qualitative methods, including quasi-experimental and single subject designs. Manuscripts should conform to the general principles described in the International Committee of Medical Journal Editor's Uniform requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication, available at wwww.icmje.org/. A research report should not exceed 4000 words.

Papers reporting on randomised controlled trials must provide a CONSORT flow diagram (http://www.consort-statement.org/Downloads/flowchart.doc) and an International Standardised Randomised Controlled Trial Number (ISRCTN).

b) Scholarly paper: clinical perspective

A scholarly paper (clinical perspective) expounds on a specific clinical approach to patient care, either imparting a specific point of view or presenting a theoretical argument. References should be sufficiently extensive to support the opinions presented in the paper. A scholarly paper should not exceed 2500 words.

c) Scholarly paper: professional perspective

A scholarly paper (professional perspective) addresses professional issues in physiotherapy, health care and related areas. The author should develop a specific point of view or present a theoretical argument. References should be sufficiently extensive to support the opinions put forward in the paper. A scholarly paper should not exceed 2500 words.

d) Literature review

Meta-analyses, systematic and narrative reviews of literature on topics of interest to physiotherapists are included in this category. In all cases, authors should conclude with specific recommendations for clinical practice and / or future research. Although authors may wish to further a viewpoint or theoretical argument, this should not be the major purpose of this paper. A review should not exceed 5000 words.

e) Case study

A case study (or report) is an indepth description of an individual's condition or response to treatment. It is often used to report on unusual or unique patients or novel interventions. It allows the clinician to explore and understand those factors important to the aetiology, care and outcome of the patient's problems, through a detailed description of a patient's background, functional status and response to treatment. Current literature, which supports the rationale for treatment and interpretation of outcomes, should be cited and discussed. A case study should not exceed 2500 words.

f) Invited Clinical Commentary

An invited scholarly paper expounding on a specific clinical approach to patient management or addressing professional issues in physiotherapy written by acknowledged experts. Authors may nominate themselves for invitation to contribute under this category through communication with the Editor or relevant Associate Editor. An invited clinical commentary should not exceed 5000 words.

g) Study protocols

A description of proposed or ongoing research, which provides a detailed account of the rationale hypotheses and methodology of the study. The paper should include details of the study design and setting, the participants or materials involved and a thorough description of all interventions and outcome measures to be used. Details of the data analysis to be undertaken should be included, including a power calculation if appropriate. Preference for publication will be given to study protocols for randomised controlled trials. If the study is a randomised controlled trial, it must have an International Standardised Randomised Controlled Trial Number (ISRCTN). A study protocol should not exceed 4000 words.

h) Clinically Applicable Papers (CAPs)

Concise reviews of recently published articles (including randomised controlled trials, diagnostic and prognostic studies, and qualitative research) that are of relevance to physiotherapy practice and have been published within the last year in other peer-reviewed journals. The purpose of these reviews is to enlighten readers about current international research that informs clinical practice decisions. CAPs must include (i) a structured abstract of the reviewed paper (prepared by the CAP author) and (ii) a commentary whereby the clinical implications of the main findings are highlighted, and their importance and applicability are discussed in relation to physiotherapy practice. Reviews are undertaken by invitation of the Associate Editor(s) for CAPS. Individuals wishing to serve as a reviewer should contact the Editor or relevant Editorial Committee member. Together the abstract and commentary should not exceed 900 words in total.

i) Reviews (books, software, videos)

Critical reviews of published papers, books, commercial software and videos of interest to physiotherapists. These reviews are to inform readers about the suitability of these resources for clinical, teaching and reference purposes. Reviews are undertaken by invitation of the Associate Editor(s) for Book Reviews. Individuals wishing to serve as a reviewer should contact the Editor or relevant Editorial Committee member. A review should not exceed 500 words.

j) Letters to the Editor

Letters to the Editor should relate specifically to articles published in the New Zealand Journal of Physiotherapy or to issues of research relevance to the physiotherapy profession. To be considered for publication, letters relating to an article must be received within eight weeks of publication of the article. Letters may be sent to the Editor via email or post (electronic correspondence is preferred).

SUBMISSION OF MANUSCRIPTS

Papers are accepted for consideration on the understanding that they have been offered to the New Zealand Journal of Physiotherapy alone, and must be accompanied by a signed declaration to this effect. Manuscripts published in the Journal are copyrighted by Physiotherapy New Zealand and may not be published elsewhere without permission. Permission to reprint Journal articles must be secured in writing from the Editor.

All manuscripts must be electronically submitted. Please email a single file (in Word format), including all text documents, tables and figures to the manuscript administrator at nzsp@physiotherapy.org.nz. A single file is preferable, however figures maybe submitted as separate files, should a single file be too large for submission.

All submissions must be accompanied by a **completed manuscript submission checklist** (obtained from the PNZ website (http://www.physiotherapy.org.nz) or you may contact the NZJP manuscript administrator for an electronic file: nzsp@physiotherapy.org.nz) and **a cover letter** stating:

- The title of the article;
- The manuscript category under which you submit the manuscript for review;
- The name of one corresponding author, and complete contact details (including postal and email addresses, telephone and fax numbers);
- The names, affiliations and email addresses of all authors of the manuscript.
- A declaration that the manuscript is being offered to the New Zealand Journal of Physiotherapy alone, and does not duplicate work that has been or will be published elsewhere. Please declare if the manuscript has been previously published as a conference paper, abstract or seminar, or if the paper is an adaptation of a presentation. State the name, date and venue of the conference or seminar.
- A statement acknowledging that the authors agree to execute a copyright transfer to Physiotherapy New Zealand, should their manuscript be accepted for publication.

We recommend authors keep copies of their paper and any correspondence submitted to the Journal. The Journal cannot accept responsibility for the loss of manuscripts.

A manuscript will be returned to authors if it does not meet the guidelines for publication in the NZJP or if the format for submission is not followed correctly.

REVIEW PROCESS

Research reports, scholarly papers, literature reviews, study protocols and case studies are all subject to external peer review. Submissions are screened for suitability by the Editor and/or an Associate Editor and if considered to be of interest to readers and potentially publishable in the Journal, are sent for review to at least two reviewers.

The Editor considers the reviewers' reports and decides whether the manuscript is:

- Accepted in its present form,
- Accepted with minor to moderate revision,
- Reconsidered if revised,
- Not suitable for publication in the Journal.

Authors are advised of the decision, and reviewers' reports are made available to the authors.

Invited clinical commentaries are reviewed by the relevant Associate Editor(s), who may, at their discretion, send the manuscript for external peer review. Critically applicable papers and reviews of books and audiovisual products are all reviewed by the relevant Associate Editor(s). Letters to the Editor are reviewed by the Editor.

The Honorary Editorial Committee reserves the right to refuse publication of any material that it does not consider appropriate for the Journal, does not meet the required standards, or fails to conform to the style guidelines for contributors.

PREPARATION OF MANUSCRIPTS

All manuscripts should be presented in the following order (each section should begin on a new page):

1. Unblinded title page
2. Blinded title page
3. Abstract and key words
4. Main text
5. Key points
6. Acknowledgements
7. References
8. Appendices
9. Tables
10. Figures

Manuscript categories (a)-(g) require an abstract, manuscript categories (a)–(f) also require a 'key points' text box. All manuscripts should be prepared with 2.5 cm margins. Beginning with the title page, pages should be numbered consecutively on the bottom right hand side. A 12 point Arial font size and double spacing should be used throughout, including title page, abstract, text, acknowledgements, references, tables and legends for illustrations. Pages and lines should be numbered.

Abbreviations should be used sparingly and only where they ease the readers' task by reducing repetition of long, technical terms. Initially use the word in full, follow by the abbreviation in parentheses. Thereafter use the abbreviation. Physiotherapists or physiotherapy must not be abbreviated to PT.

Measurements must be given in metric units. Statistics, measurements and ages should always be given in figures (e.g. 10 mm) except where the number begins a sentence. Numbers that do not refer to a unit of measurement or are less than 10 should be spelled out. Spelling should conform to the Concise Oxford Dictionary of Current English Usage.

1. UNBLINDED TITLE PAGE

This page must contain the following:

- The title of the article which should not exceed 20 words;
- The author(s) name(s) written in full;
- No more than three relevant professional and academic qualifications for all authors;
- Current position(s) and institutional affiliation(s) of each author;
- The name of the corresponding author, and complete contact details (include postal and email addresses, telephone numbers);
- Any sources of funding;
- A word count of the main text, excluding abstract and references;
- The number of figures and tables included in the manuscript.

All individuals listed as authors must qualify for authorship credit under the criteria defined by the International Committee of Medical Journal Editors Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication, www.icmje.org and all those who qualify should be listed. Refer to the Editorial New Zealand Journal of Physiotherapy (2006; 34:1-2).

2. BLINDED TITLE PAGE

On a separate page, include only the title of the manuscript.

3. ABSTRACT AND KEY WORDS

All papers must include a brief but informative abstract of 150 to 200 words. The abstract should describe the purpose, basic procedures, main findings, and principal conclusions of the study. The abstract should be one paragraph and not contain subheadings, abbreviations or references. Please provide up to five key words to assist with indexing of the article (if possible select your key words from the Index Medicus Medical Subheadings (MESH) website).

4. MAIN TEXT

For research papers, the main text must include the following section headings: introduction; methods; results; discussion and conclusion. All articles should include an introduction that provides the background to the paper, and describes its purpose and relevance to physiotherapy. Reference should be made to an established theoretical background and/or background literature. The implications of this work for physiotherapy practice, and further research, and/or conceptual development should be clearly described.

5. KEY POINTS' TEXT BOX

All manuscript categories (a-f) must include a 'key points' text-box containing no more than four key points.

6. ACKNOWLEDGEMENTS

The source of financial grants and substantial contributions by individuals or institutions should be acknowledged. Authors must explicitly declare if they had "no financial support." The written permission of each person acknowledged must be obtained, as readers may assume that acknowledgement means endorsement of the data or statements made by the author(s).

7. REFERENCES

a. Citation in the text

Any citation within the text of a document should be linked to the corresponding bibliographical reference. In the text, refer to a particular document by using the author's surname and year of publication. Please note that citations are separated by commas, and there are no commas between author's names and the year of publication.

- If the author's name occurs naturally in a sentence, the year is given in brackets: 'as defined by O'Sullivan (2009)'. If not, then both the name and year are shown in brackets: 'In a recent study (Willis 2008), rehabilitation for people with stroke was considered…'
- If the same author has published more than one cited document in the same year, use lower case letter to distinguish publications: 'as hypothesised by Brown (2010a), the …'
- When two author's names occur naturally in the text, the format is: 'as reported by Sherrington and Lord (2009).'
- If not then observe this format: 'Researchers note the impact of age on outcome for this group (Smith and Wallace 2008).'
- When there are three or more authors on a paper, only give the surname of the first author, followed with 'et al'. Do not use full stops.
- The format to be used when the citation occurs naturally within the text is: 'as noted by Hunter et al (2006), relationships between…'
- In all other circumstances, please follow this format: 'was demonstrated in a longitudinal study (Cook et al 2008).'
- When citing more than one paper, order the surnames of the first author alphabetically: '(Cook et al 2008, O'Sullivan 2009, Smith and Wallace 2008).'
- When quoting directly from another author, place the quote in inverted commas and include the page number on which the quotation appears: Sims et al (2002) concluded that 'appropriate rehabilitation is crucial both as a preventative measure and as a critical part of post operative care' (p.691).

b. Reference List

Journal reference

- There are no spaces between the authors' initials
- Commas separate authors names with the exception that 'and' is used between the last two authors.
- Only include the volume of the journal and give page numbers in full, that is 82-87, not 82-7.
- The journal title should appear in full and italics, and omit 'the' if it appears at the beginning of a journal title.
- Write out the word 'and' even if an ampersand (&) has been used in a journal title of name of a publishing company.

Example:

Schoo AMM, Morris ME and Bui QM (2004) Influence of home exercise performance, concurrent physical activities and analgesics on pain in people with osteoarthritis. *New Zealand Journal of Physiotherapy* 32: 67-74

Book reference

- Include the author's surname and initials, title of the book and edition (if not the first), name of the publisher and place of publication.
- Use initial capitals for the title of the book, but not for chapters contained within it.

Example:

Portney LG and Watkins MP (1993) Foundations of Clinical Research: Application to Practice. Connecticut: Appleton and Lange, pp. 210-220.

- For books with more than one edition, specify the edition.

Example:

Levangie PK and Norkin CC (2005) Joint Structure and Function: A Comprehensive Analysis (4th ed) Philadelphia: FA Davis Company, pp. 15-17.

Referencing a book chapter

- If there is one editor write '(Ed)', but for more than one editor use '(Eds)'

Example:

Lou JQ (2002) Searching the evidence. In Law M (Ed): Evidence Based Rehabilitation. New Jersey: SLACK Inc, pp. 71-94.

Thesis reference

Example:

Avery AF (1996) The reliability of manual physiotherapy palpation techniques in the diagnosis of bilateral pars defects in subjects with chronic low back pain. Master of Applied Science thesis, Curtin University of Technology, Perth,Western Australia.

Reference to a conference publication

Example:

Ada L (2004) From research to practice: new directions for intervention after stroke. Proceedings of the National Conference of Physiotherapy New Zealand, Christchurch, pp. 1.

References to websites

- State the date the site was accessed.

Example:

New Zealand Guidelines Group (2003) The Management of Soft Tissue Knee Injuries: Internal Derangements. http://www.nzgg.org.nz/guidelines/0009/ACC_Soft_Tissue_Knee_Injury_Fulltext.pdf (Accessed January 31, 2006).

Reference to a publication from a corporate body

Example:

Accident Compensation Corporation (2000) Physiotherapy Treatment Profiles, Wellington, New Zealand.

Reference to a personal communication

Example:

Ross DE (2009) Personal communication

Please note: This style of referencing is the same as that used for the Journal of Physiotherapy. Endnote users can download this Endnote style from the website: http://www.physiotherapy.asn.au/index.php/quality-practice/ajp/author-guidelines Alternatively, you may contact the NZJP manuscript administrator for an electronic file: nzsp@physiotherapy.org.nz.

8. APPENDICES

Appendices are used to provide essential material not suitable for figures, tables or text. These are numbered consecutively and placed at the end of the paper following the references.

9. TABLES

- Tables capture information concisely and display it efficiently; they also provide information at any desired level of detail and precision. Including data in tables rather than text frequently makes it possible to reduce the length of the text.
- Type or print each table on a separate sheet of paper. Number tables consecutively in the order of their first citation in the text and supply a brief title for each.
- Do not use internal horizontal or vertical lines. No outline border is required on the sides of the table. See example below.
- Title of table to be in bold and situated above the table.
- No bold or italics within the table.
- Give each column a short or an abbreviated heading.
- Consider the length and size of the table; larger tables may be clearer when information is divided into two tables.
- Be consistent with data format / line justification within each table. Generally, text tables are left justified and numbers or check marks are centered.
- Authors should place explanatory matter in footnotes, not in the heading. Explain all nonstandard abbreviations in footnotes, and use the following symbols, in sequence: *, †, ‡, §, ll, ¶, **, ††, ‡‡, §§, llll, ¶¶, etc.
- Identify statistical measures of variations, such as standard deviation and standard error of the mean.

Example:

Table 1: Measure A and B Results

Participant	Measure A	Measure B
A	One	1
B	Two	2
C	Three	3
D	Four	4

10. FIGURES

- Figures must be provided in an electronic format that will produce high-quality images (for example, JPEG or GIF). Authors should review the images of such files on a computer screen before submitting them to be sure they meet their own quality standards.
- Letters, numbers, and symbols on figures should be clear and consistent throughout, and large enough to remain legible when the figure is reduced for publication.
- Figures should be made as self-explanatory as possible. Titles and detailed explanations belong in the legends, not on the illustrations themselves.

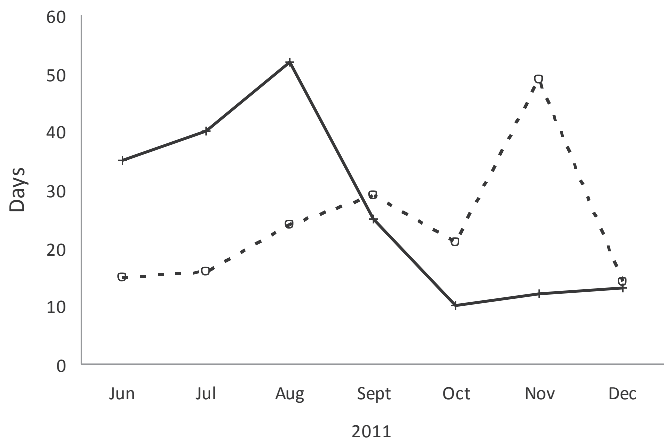
- Size figures to fit within the column width (81mm) or the full text width (171mm) of a journal page.
- No border required surrounding the outside of the figure.
- No bold or italics to be used in the figure (unless at discretion of the Editor)
- Photographs of potentially identifiable people must be accompanied by written permission to use the photograph.
- Figures should be numbered consecutively (Arabic numbers) according to the order in which they have been cited in the text.

Legends for Figures:

Place figure legends above the Figure. When symbols, arrows, numbers, or letters are used to identify parts of the figure, identify and explain each one clearly in the legend.

Example:

Figure 1: Patient wait times to first specialist appointment in 2011, for Priority A referrals (dashed line) and Priority B referrals (solid line)



11. PERMISSIONS

a. Ethics

Research reports on human participants or animals must include a statement that the study was approved by a properly constituted ethics committee and provide the number allocated to the study. The statement should affirm that informed consent was obtained from human participants.

b. Photograph Release

If photographs of people are used, either (i) the participant facial features must be sufficiently obscured to conceal the participant's identity) or (ii) if persons are recognisable, their pictures must be accompanied by written permission to publish. This statement must be signed by the participant, parent, or guardian.

c. Reprinting Tables and Figures

Authors must obtain and submit written permission from the original sources if reproducing previously published illustrations, photographs, figures, or tables. Permission obtained must explicitly permit reproduction in the New Zealand Journal of Physiotherapy.

ACKNOWLEDGEMENTS

We acknowledge reference to the guidelines developed by the International Committee of Medical Journal Editors of Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication http://www.icmje.org/index.html (Last accessed January 2012) and the Journal of Physiotherapy guidelines for authors when preparing these guidelines.

NEW ZEALAND JOURNAL OF PHYSIOTHERAPY

SUBMISSION CHECKLIST

To be completed and sent in electronically with manuscript at submission.

Incomplete submissions will not be sent for peer review until requirements are met.

A detailed description of each item listed below is provided under the appropriate heading in the Guidelines for Contributors. Please tick below that each item has been addressed, then name and date this form at the end prior to submitting.

- ❑ Cover letter with all requested information has been submitted.
- ❑ The manuscript strictly adheres to the instructions provided in the guidelines.
- ❑ The references are correctly formatted as per guideline instructions.
- ❑ Tables and figures are correctly formatted as per guideline instructions.
  If this is a randomised controlled trial, a the CONSORT flow diagram has been provided *(http://www.consort-statement.org/Downloads/flowchart.doc)*.
- ❑ International Standardised Randomised Controlled Trial Number (ISRCTN) is cited in papers reporting on study protocol or randomised controlled trials.
- ❑ Where appropriate human and animal experimentation has been approved by a properly constituted ethics committee; and a statement to this effect has been provided within the text of the manuscript, along with the ethics reference number allocated to the study by the ethics committee.
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MSMX 702 Musculoskeletal Tissues
MSMX 703 Musculoskeletal Disorders
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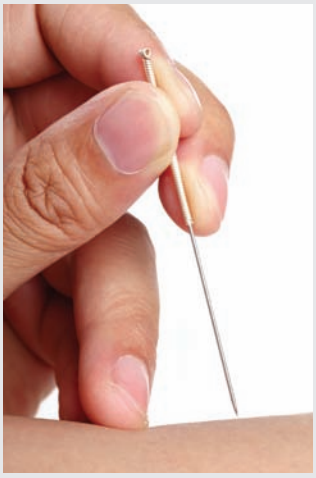

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