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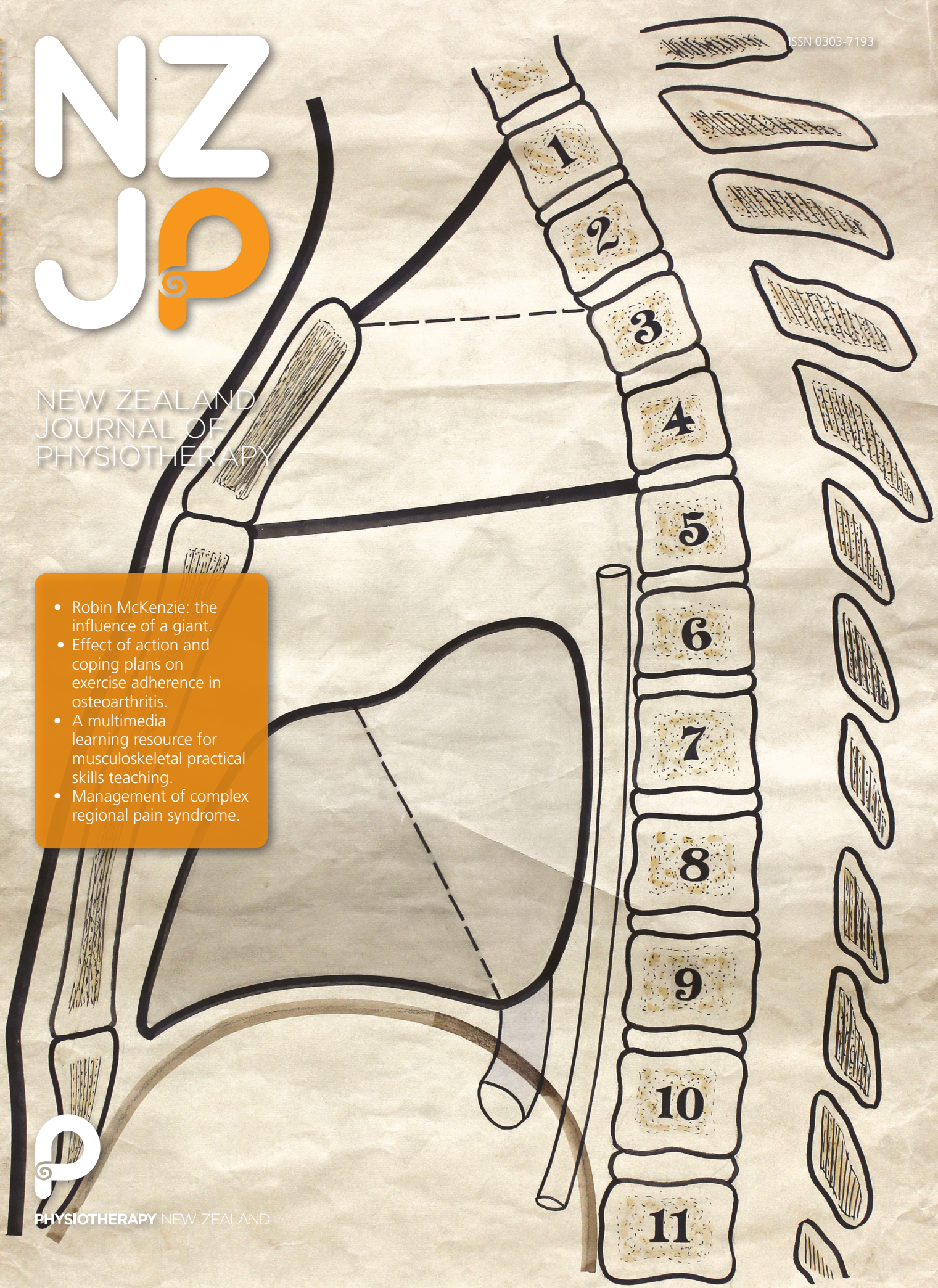

- Robin McKenzie: the influence of a giant.
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- A multimedia learning resource for musculoskeletal practical skills teaching.
- Management of complex regional pain syndrome.

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Robin McKenzie: the Influence of a giant

Robin McKenzie *CNZM, OBE, FCSP (Hon), FNZSP (Hon), Dip MDT, Dip MT*

On 13 May 2013 Robin McKenzie passed away after a short battle with cancer. As we mourn the loss of a local physiotherapist who contributed immensely to establish physiotherapy as a respected and valued profession in New Zealand, so too does the world mourn the loss of an 'influential giant' who changed the careers of many health professionals and assisted thousands of patients to live painfree lives. But Robin was more than just a physiotherapist. As we reflect back on his life and the impact he had on so many people, we also remember his great love for his family and the value he placed on empowering others to fully reach their potential in life.

The McKenzie Method of Mechanical Diagnosis and Therapy (MDT) was developed by Robin following a chance discovery in 1956 and is based on the effect the correct position and movement can have on mechanical pain. What can be forgotten when we gloss over the facts and dates, is that it took nearly 30 years of Robin attending meetings, conferences, travelling internationally, teaching courses, and writing books, for MDT to start to be accepted by health professionals. It has taken another 30 years for MDT to be accepted as a valid assessment and treatment option for patients presenting with mechanical back or extremity pain. That demonstrates Robin's incredible tenacity, strength of character, and desire to help as many people who were suffering as he was able to, even when he faced persistent opposition to his work. In 2009 he published his autobiography, Against the Tide (McKenzie 2009), in which he describes the battle fought for MDT to gain acceptance. Due to his humility and empathy, right through the ensuing nearly 60 years patients continued to be at the centre of Robin's drive, as shown by the fact he dedicated his autobiography to his patients. Even recently he was concerned that there are still millions of people around the world suffering from back pain who have not received effective and appropriate treatment yet.

In 1982 Robin established the McKenzie Institute International (MII) to educate health professionals in, and promote the principles of, the management of musculoskeletal disorders using MDT. Robin's vision was that as many people in the world who needed help with their mechanical pain were able to receive it, and he knew early on that to achieve that vision he would need to involve others. Robin passed on his theories and experiences through conferences and courses, and trained Faculty Instructors to also teach MDT to other health professionals. Over time the educational process developed to its present structure of four 4-day courses followed by a Credentialing Examination. Once the Credentialing Examination has been passed a therapist may enrol for the post-graduate Diploma in Mechanical Diagnosis and Therapy (Dip MDT), which is now completed through Dundee University in Scotland. To assist in the education process Robin wrote the lumbar spine textbook in 1981 (McKenzie 1981) and the cervical and thoracic spine textbook in 1990 (McKenzie1990). Due to the growth in the depth of understanding of the MDT principles, and the extent of the research validating it, Robin re-wrote both these textbooks in 2003 (McKenzie and May 2003) and 2006 (McKenzie and May 2006), as well as writing the text book on the extremities in 2000 (McKenzie and May 2000). A glimpse into the humility and vision of Robin is seen by the fact he realized that his work could have an even greater reach and impact if he included others who were more experienced in the writing process, so he invited Dr Stephen May in the UK to co-author all the recent textbooks.

Through Robin's leadership, vision, empowerment, and encouragement, the McKenzie Institute International, which is a non-profit organisation, now has branches in 28 countries, and courses are being taught in a further 14 countries. There are 77 teaching faculty throughout the world, 374 holders of the Dip MDT, and over 5000 credentialed therapists internationally. Throughout the 23 years I have known Robin a common theme in many of our conversations was the need to help more clinicians become more effective to help more patients. It was never about his own ego, or personal recognition, but rather trying to help as many people as possible. And that humility and empathy has permeated throughout the McKenzie Institute, with many people commenting that attending one of the MII conferences or seminars anywhere in the world is like attending a family gathering. There is no room for egos and selfish ambitions; because Robin's reminder to us was always to remember it is all about the patient and not ourselves.

One of Robin's strengths was his deep sense of curiosity and searching for proof that the principles of MDT were founded on scientific truth. I will never forget the McKenzie Institute International conference in Dallas, Texas in 1991 when Michael Adams presented his paper demonstrating the anterior and posterior movement of the nucleus pulposus in response to flexion and extension (Adams and Dolan 1995). Robin told me later how excited he was that what he had said could happen was finally being proven to be true. Over the next 20 years more proof has followed that the disc can behave in the way Robin suggested. There is more research needed to relate the movement of structures to the actual production and abolition of pain, but we now know more about the potential structures involved. We know that not all derangements originate from a discogenic source, but the fact that the scientific evidence now exists that structures in the spine behave in certain ways, validates Robin's early hypotheses of the origin of mechanical low back pain. Robin always encouraged research into the cause and treatment of low back pain, and was always an avid reader of any relevant published studies. I asked him once if he was concerned about the extent of research looking at MDT and he said that it was great, as long as the methodology was of a high scientific level. It was almost like he was saying 'bring it on' as he knew that what he saw occurring in patients, and had been successfully replicated by therapists around the world for many decades, would stand up to thorough, accurate, high-quality, scientific scrutiny. To date there are over 200 relevant research articles for the lumbar spine listed on the research page of the McKenzie Institute International website (http://www.mckenziemdt.org/libResearchList.cfm?pSection=int) . However, there is a need for further research in order to find more answers to the question of how we treat more patients more effectively. One of the issues Robin and I discussed frequently was the difference between what

we experience in the clinic as clinicians and what the researchers find in their studies. I learnt through these conversations about the intricacies of research and the importance of sound methodology. When a paper was published that supported MDT Robin would always caution us to not get excited until several high quality papers had the same result.

The McKenzie Method of Mechanical Diagnosis and Therapy, however, is not only for the treatment of low back pain. Early in the process of developing MDT Robin discovered the same principles could be used for treatment of mechanical pain in the cervical spine, the thoracic spine, and the extremities. On the surface MDT is a simple system. But behind it lies a complex level of understanding of the presentation of mechanical pain. A patient attending a clinic of an MDT trained clinician will be examined to determine if the pain, wherever it is in the musculoskeletal system, is mechanical in origin. If so, does it fit into one of the three sub groups? If so, does it have a directional preference? If so, which is the specific exercise the patient needs to perform as their self-management programme? This has been Robin's greatest gift to clinicians. To offer them a simple yet complex system for identifying patients they are able to effectively treat, and then giving them the tools to be able to do so. Robin's greatest gift to patients was to believe in their ability to treat themselves, once they had been effectively taught how to do so. A strong focus of MDT has always been on patient education. In the 1980's Robin began publishing his Treat Your Own Back (McKenzie 1980) and Treat Your Own Neck (McKenzie 1983) books in order to provide a tool for millions of people around the world who will suffer from mechanical back and neck pain at some point in their lives. To date, over 6 million copies in 7 languages of Treat Your Own Back and Treat Your Own Neck have been sold. Recently Treat Your Own Shoulder (McKenzie et al 2009) and Treat Your Own Knee (McKenzie et al 2012) have been added to the series by Robin encouraging Grant Watson and Robert Lindsay to join his writing team. This again demonstrates Robin's willingness to pass the mantel on, empowering others to fulfil their potential, and to further the dream of helping more patients to treat themselves.

Approximately 13 years ago Robin suffered his first bout of ill health. In true Robin style, he kept his situation quiet to avoid attention on himself, but he changed focus to ensure the McKenzie Institute International and MDT would be secure and robust for a long future, beyond his life span. Since its inception the Institute has been overseen by a Board of Trustees from around the world, with a CEO being responsible for the daily functioning of the Institute, and with Robin as the president. Over the past 10 years he has gradually stepped back to enable others to step forward, being empowered and mentored by Robin himself. The McKenzie Institute is in an incredibly strong position now. Lawrence Dott, who has been the CEO since 1991, continues to effectively guide and lead the Institute's branches to achieve their personal strength. Dr Helen Clare, as the International Director of Education continues to successfully lead the forward-thinking International Education Committee to ensure the educational programme is relevant, uniformly-structured, and current for this technological age. And Uffe Lindstrom, as the Chairman of the Board of Trustees, continues to wisely lead the Institute forward in his governance role.

The future of the McKenzie Institute International and the McKenzie Method of Mechanical Diagnosis and Therapy is strong. Robin will be missed by many of us for a long time. He was a man of integrity, vision, empowerment, curiosity, tenacity, and empathy. In 2004 Robin was voted the Most Influential Giant by American orthopaedic physical therapists due to the impact he had had enabling clinicians to effectively treat patients. He received many honours both in New Zealand and internationally, but he remained a humble man who wanted to help more patients, avoid the limelight, and for people to fulfil their potential. He was not afraid to challenge people's beliefs and he ruffled a few feathers in his time, but that again demonstrates the depth of his desire not to settle for anything but the best for people. He was known for his incredible generosity as seen by him setting up a scholarship to enable new graduate New Zealand physiotherapists to partake in the MDT educational process, and by always being available for clinicians around the world to contact him and ask advice. He will be missed by many. But as Uffe Lindstrom said at the recent European McKenzie Institute meeting, 'this is not the end...it's not the beginning of the end...it's actually the end of the beginning.' Due to Robin's foresight and passion, he has left the Institute and MDT in incredibly strong positions. It is now up to us to continue his legacy of treating patients with mechanical pain by teaching them to treat themselves. A mighty totara has fallen, but the forest remains strong and Robin's legacy will go on.

Celia Monk
New Zealand Faculty Member of the McKenzie Institute International.

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28 April 2013

Dear Editor

Regulation of New Zealand Physiotherapists over the past 100 Years

The review of regulation of the physiotherapy profession in New Zealand in the March 2013 centennial issue of the journal (Grbin 2013) only briefly mentions the Acts prior to Health Practitioners Competence Assurance Act (HPCAA), and mostly discusses the HPCA Act under which the profession has only been regulated since September 2003. As an historical review of the regulation of the Physiotherapy profession and the practice of Physiotherapy in New Zealand, there are some key omissions and milestones important to note.

The Physiotherapy Act 1949 regulated the profession in New Zealand for fifty-four years of the past 100 years, and was surprisingly forward thinking in some respects for that time. It introduced further Disciplinary Powers (section 24) to those under the previous Masseurs Registration Act 1920 (MRA) and its Amendments, being those for "gross negligence or malpractice or grave impropriety or misconduct", as well as for physiotherapists "convicted of an offence punishable by imprisonment". These were quite apart from the "fitness to practice" sole provision mentioned in the recent review (Grbin 2013) for mental illness, (under the 1949 Act those for disability were clearly stated under section 22 "Notification of Disability and suspension of registration" as provisions for physiotherapists deemed to be "unable to perform his professional duties satisfactorily due to mental or physical disability" by a medical superintendent of a hospital or a medical practitioner (1964 amendment)). The 1949 act also protected more than the title of "masseur" or "massage expert" as protected in the 1920 MRA, adding the protection of the use of the names and titles "Physiotherapist" and "Physical Therapist", as well as the use of "any written words, initials, or abbreviations of words intended or likely to cause any person to believe that he is registered under this Act or is engaged in the practice of physiotherapy or any branch of physiotherapy or that he is qualified to practise physiotherapy or any branch of physiotherapy". This was at a time well before the appearance of the numerous non-registered and "alternative health" practitioners, massage and exercise therapists who have emerged in more recent years. The NZSP and successive Boards advocated strongly over many years for a review of the 1949 Act to better protect the public of New Zealand, particularly in the areas of discipline, fitness to practice, and also the need to link ongoing competence to the issue of Annual Practising Certificates.

Servicing of the Board's activities / administrative functions under the 1949 Act was all undertaken by the Department of Health / Ministry of Health. The Chair of the Board was always the Director General of Health (or his nominee), and even the Registrar was an employee of the Health Department/Ministry of Health, being the Advisory Physiotherapist until the restructuring of the Ministry of Health in 1991, which removed the roles of Advisory Physiotherapists, and therefore the positions of Registrar and Deputy Registrar were no longer physiotherapists but employees of the Ministry, who serviced several Boards. The membership of the Board was prescribed under the Act, as it was under the MRA 1920, and there were no lay persons, the only non physiotherapists being the Chair and two medical practitioners. Until the HPCA Act came into force, the 1949 Act underwent several Amendments and changes to Regulations. The fifty pound penalty stated in the recent review (Grbin 2013) had actually risen to $10,000 (still inadequate) by the time the 1949 Act was replaced by the HPCAA.

A significant omission in the Grbin (2013) account of the history of the legislation is The Physiotherapy Amendment Act 1999. Without the enactment of this important legislation, the Physiotherapy Board would neither have had the capacity nor capability for the many huge changes and operational functions it would be facing following the enactment of the HPCAA. In 1996, the Health Occupational Registration Acts Amendment Bill (HORAAB) was drafted, its purpose being to amend eleven health occupation regulation statutes, including the Physiotherapy Act 1949. This proposed legislative amendment was to be a prelude to an "umbrella Act" that would cover all NZ Registered Health Practitioners, the blueprint for this proposed Act being the Medical Practitioners Act 1995, which included provisions for the review of ongoing competence, physical and mental fitness to practice, scopes of practice, registration of specialisation and the ability to restrict or supervise practice. The HORAAB was passed in the house on 6 October 1999 and came into force seven days later and amended the 1949 Act again as the Physiotherapy Amendment Act 1999.

The changes this enabled were major – the Board's status changed to a "Body Corporate with perpetual succession" with the "rights, powers and privileges" and "all the liabilities and obligations of a natural person of full age and capacity". It removed the Ministry of Health employed officials (the Chair and Registrar) from the Board, amended the prescribed composition of the Board to eight members from nine, included two lay members for the first time, removed the right of Board membership of the heads of the "approved training schools" (amending this to "not more than one person involved in teaching physiotherapy"), gave authority for the Board to elect its own Chair and Deputy Chair for the first time in the history of the regulation of Physiotherapy, and gave authority for the Board to employ and appoint its own staff, including a requirement to appoint a Registrar and Deputy Registrar, and the ability to employ any other staff or agents. Under this Act, the Board was, for the first time, able to operate independently from the joint Occupational Registration Boards Secretariat housed in the Ministry of Health, and select and employ its own dedicated staff, which considerably improved responsiveness, efficiency and effectiveness of the Board's operational activities, and allowed the Board to prepare the operational infrastructure and develop governance policies to support the Board's activities and be ready for the additional requirements and functions under the proposed HPCAA. The Physiotherapy Amendment Act 1999 also increased the level of fines, required an Annual Report to the Minister of Health, and made the Board financially independent of the other Boards. It required the Board to open a bank account and appoint a Chartered Accountant as auditor of the financial activities of the Board, permitted the prescription of a range of fees, permitted the imposition of a disciplinary levy on all practitioners, and permitted the Board to use modern technology and media to hold meetings and make binding decisions.

The first CEO/Registrar of the Physiotherapy Board commenced his employment in March 2000, and the first lay members were appointed by the Minister of Health in October 2000.

Grbin (2013) mentions the development of the 1999 "entry level competencies for physiotherapists" document. However, it should be noted that this document was based on a full revision and update of the first "Registration Requirements – Competencies and Learning Objectives" published by the Board in 1988, from which the Schools of Physiotherapy developed their first four year degree curriculae. This original document proved to be extremely important as evidence of the need for the Physiotherapy undergraduate training in New Zealand to require a funded four year degree to meet these competencies, rather than three years (which the Ministry of Education would only fund). The Board undertook a detailed project and sought documented opinion from Australian and British senior Physiotherapy Educators, as physiotherapy students had to fund their fourth year until the Board's efforts achieved success in gaining the funding of the fourth year in 1998.

The Grbin review (2013) clearly sums up the value of appropriate statutory regulation, as now provided by the HPCAA, which addresses the deficiencies in prior legislation. The review also reinforces the need for the Board to have a more active role in workforce planning to better meet the changing health needs of the NZ public, as well as keeping the physiotherapy workforce informed of any lessons learned and recommendations from adverse outcomes or near misses, thus ensuring continuous quality improvement.

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The effect of action and coping plans on exercise adherence in people with lower limb osteoarthritis: a feasibility study

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ABSTRACT

The known benefits of exercise for lower limb osteoarthritis are limited by poor patient adherence to them. Action and coping plans do enhance treatment adherence. This feasibility study investigated the effects of action and coping plans on adherence, self-efficacy and functional performance in people with lower limb osteoarthritis; and tested the study protocol for a larger study. Twenty seven people with hip or knee osteoarthritis were randomly allocated to the exercise plus action and coping plans (intervention) group (n=17) or exercise only (control) group (n=10). Participants undertook a 12 week gym based exercise programme along with a home exercise programme. Exercise self-efficacy and physical function were measured pre- and post-study, and exercise adherence throughout. Data were analysed statistically. There were no significant differences between the two groups' adherence rates, and one significant difference between the two groups' self-efficacy scores. The intervention group improved significantly in four of the five physical measures, whereas the control group significantly improved on only one measure. Action and coping plans appear to have had a beneficial effect on physical function, limited effect on self-efficacy and no effect on exercise adherence. A larger study is required to ascertain the true merit of action and coping plans.

O'Brien D, Bassett S, McNair P (2013) The effect of action and coping plans on exercise adherence in people with lower limb Osteoarthritis: a feasibility study.New Zealand Journal of Physiotherapy 41(2): 49-57.

Key Words: Osteoarthritis, exercise, adherence, action and coping plans, self-efficacy

INTRODUCTION

Osteoarthritis (OA) is a joint disease characterised by pain, decreased function (Goldring and Goldring 2010) and reduced quality of life (Cook et al 2007). Management has predominantly been pharmaceutical and/or surgical (Hunter and Lo 2008), despite international guidelines advocating the use of exercise-therapy (Mazieres et al 2008, Roddy et al 2005, Zhang et al 2007). Exercise-therapy is known to improve function and quality of life in people with OA (Fransen and McConnell 2009, Mikesky et al 2006), leading to less reliance on health services (Fransen and McConnell 2009). Nonetheless, the effectiveness of these programmes is governed to some extent by people's adherence to them, and if higher levels of adherence could be achieved then it could be expected that their effectiveness would improve (Fransen and McConnell 2009, Pisters et al 2010a).

Behaviour change strategies, such as implementation intentions in the form of action and coping plans have been found to improve adherence to the exercise component of cardiac rehabilitation programmes (Sniehotta et al 2005). Implementation intentions are planning strategies which outline how the behaviour will be performed (Gollwitzer, 1999). Action plans require people to state how, when, where and with whom they are going to undertake the behaviour such as exercise, whereas coping plans assist individuals to overcome the barriers to successful completion of the exercise (Sniehotta et al 2005). Nonetheless, it is not known whether these plans are effective adherence enhancing adjuncts to exercise programmes for people with OA (Pisters et al 2010b). Therefore, this feasibility study tested specific protocols in preparation for a larger investigation of the effect of action and coping plans on adherence to exercise programmes for people with OA of the lower limb. It was hypothesised that participants who received the action and coping plans would have higher levels of self-efficacy and adherence, and better function following the exercise programme, than those who did not. It was also hypothesised that there would be significant relations between adherence, post-study self-efficacy and post-study functional performance.

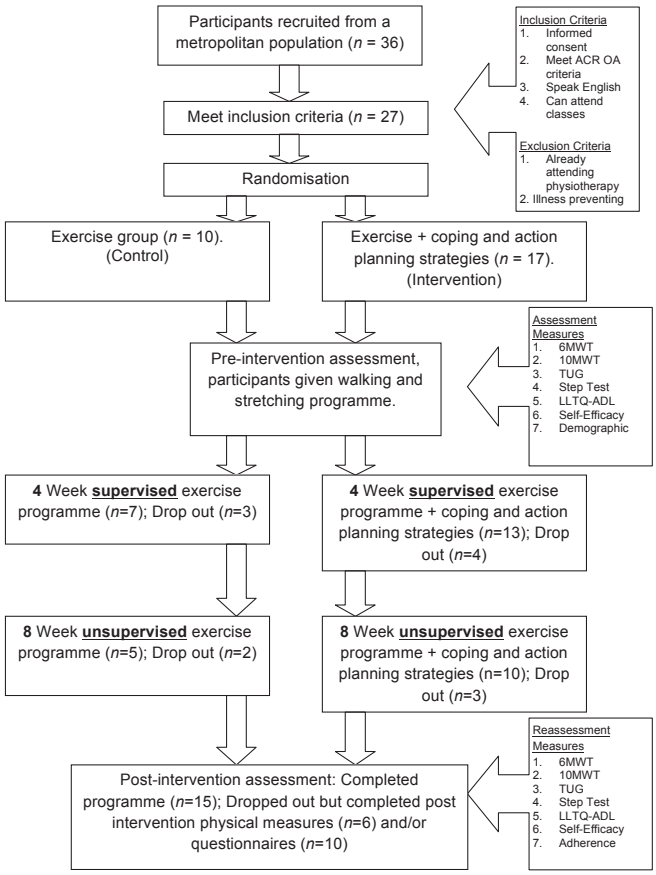
METHODS

Study Design

This feasibility study was a two group, randomised controlled design with testing at the beginning, during and at the end of the exercise programme. The sample size was based on the recommendations of Thabane et al (2010) for pilot studies. Participants were randomly assigned to either the intervention (exercise plus action coping plans) or control (exercise only) group with the use of a computer-generated random number table. The sample size was defined and the computer programme allocated participant numbers to one of the two groups. Participant numbers were generated by the order in which people enrolled in the study. The intervention group received an exercise programme plus action and coping plans and the control group received only the exercise programme. The dependent variables were adherence, self-efficacy, and functional performance. Research assistants collected the

data, supervised the exercise classes and were blinded to the participants' group allocation. The researcher, who assisted the participants to develop the action and coping plans was blinded to the baseline and post-intervention scores of the participants as well as their adherence scores until the completion of the study. See Figure 1 for the study design, and the participants' progression through the study.

Figure 1: Study design showing the flow of participants through the study



Abbreviations: ACR: American College of Rheumatology, OA: Osteoarthritis, 6MWT: 6 minute walk test, 10MWT: 10 metre walk test, TUG: timed up and go, LLTQ-ADL: lower limb task questionnaire – activities of daily living

Participants

Twenty seven people with hip and/or knee joint OA who met the inclusion criteria were recruited. Participants needed to meet the classification criteria defined by the American College of Rheumatology (radiographic evidence of OA changes, joint pain on most days of the last month, as well as three of the following; aged 50 years or older, morning joint stiffness longer than 30 minutes, crepitus, bony tenderness, bony enlargement and no palpable warmth; Altman et al 1986), have good command of the English language and be able to undertake exercise. People were excluded if they were already undergoing physiotherapy or had a disorder/illness that prevented them from exercising. Thirty six people initially expressed an interest in the study, with 27 enrolling, and 15 completing the programme.

Measures

Demographic and Osteoarthritis Characteristics

The Physical Activity Readiness Questionnaire (PAR-Q: Chen et al 2009) was modified for this study for collection of demographic and OA characteristics information. In addition to the standard PAR-Q form, the modified questionnaire also included OA characteristics, such as duration and location of symptoms.

Adherence

As adherence to exercise programmes requires a diverse range of behaviours, its measurement was multifaceted (Brewer 1999).

(i) Attendance and Programme Completion: Participants were encouraged to attend three classes per week, and their attendance was recorded at the beginning of each class. Class attendance was measured by the number of classes each participant attended over the 12 week programme. Programme completion was defined as attending a minimum of one class per week for the 12 weeks; allowances were made if participants were sick or had a planned absence during the study (i.e. holiday).

(ii) Class-Based Adherence: Participation during the class-based sessions was measured with the Sport Injury Rehabilitation Adherence Scale (SIRAS), which has three items, scored on a five point incremental scale. The supervisor scored the participants' exercise intensity, their ability to follow instructions and their receptiveness to changes to the programme during the session. The SIRAS has acceptable test-retest reliability (ICC = 0.77, Brewer et al 2000b), and good internal consistency (alpha = 0.82, Shaw et al 2005).

(iii) Home-based adherence was measured by a participant self-report scale. It consisted of two items measured by a five increment scale (1 = *not at all* to 5 = *as advised*), that required the participants to rate the extent to which they followed each of the walking and the stretching programmes (Bassett and Prapavessis 2007). This measure has acceptable internal consistency (α = 0.78, Bassett and Prapavessis 2007).

Self-Efficacy

Self-efficacy beliefs are known to differ from starting a new behaviour to maintaining it (Scholz et al 2005), therefore the use of phase specific self-efficacy measures were deemed appropriate.

(i) Exercise phase specific self-efficacy was measured by self-report scales of task, maintenance, and recovery self-efficacy. Participants responded to items adapted from previous research using a four-point Likert response scale (1 = *strongly disagree* to 4 = *strongly agree*) (Sniehotta et al 2005). Each item in each scale commenced with either *'I am confident that'* or *'I am able to'* or *'I can'*. Task self-efficacy was a four-item scale that measured the participants' perceived ability to undertake the prescribed exercise programme, maintain their general fitness and follow the advice given about exercising. Maintenance self-efficacy was a four-item scale that measured the participants' perceived ability to maintain the prescribed exercises. Recovery self-efficacy was a three-item scale that measured the possibility that the participants could have lapses in their exercise programme. Previous research (Scholz et al 2005) reported that these scales have acceptable internal reliability. The Cronbach

alpha scores for each of these scales was 0.75, 0.73 and 0.85 respectively.

Functional Performance

Functional performance was measured by four objective measures and one participant self-report scale.

(i) The Timed Up and Go (TUG) test measures peoples' functional mobility (Podsaidlo and Richardson 1991). Participants sat in a chair, when instructed they rose from the chair with the use of their arms, walked around a three metre mark and returned to the seat. The TUG has high test-retest reliability (ICC = 0.80, Kennedy et al 2005).

(ii) The Ten-Metre Walk Test (10MWT) measures maximal walking speed (Freter and Fruchter 2000). Participants were required to walk as quickly as possible for a length of 10 metres with the time taken to cover the distance measured. It has high test-retest reliability (ICC = 0.91, Kennedy et al 2005).

(iii) The Step Test measures the number of times stepped up and down a single 20 cm step in 15 seconds, with the more steps completed being an indication of greater lower limb strength and dynamic balance. This test is reliable in patients with OA (r = 0.90, Kennedy et al 2005).

(iv) The Six-Minute Walk Test (6MWT) measures people's functional physical capacity (Kennedy et al 2005). Participants walked as quickly as possible along a flat 20-metre track turning around a marker placed at each end for six minutes. Any rests the participants had were included in the six minutes and the distance covered during this time was recorded. The 6MWT has high test-retest reliability (r = 0.94, Kennedy et al 2005) and correlates with perceived functional measures (r = 0.83, Stratford et al 2006).

(v) The Lower Limb Task Questionnaire (LLTQ, McNair et al 2007) is a self-report measure of physical function and consists of two scales, recreational activities and activities of daily living (ADL). Only the ADL subscale was used because an initial validation study testing people with OA found it was more appropriate than the recreational sub-scale (LLTQ, McNair et al 2007). The LLTQ-ADL subscale has ten activities each of which the participant rated on a five increment scale with 0 = *unable to complete* and 4 = *no difficulty to complete*. The LLTQ-ADL subscale possesses good factor structure and composition, and shows high levels of internal consistency (Cronbach alpha = 0.91, McNair et al 2007).

Exercise Programme

All participants were encouraged to attend three exercise sessions per week in the University's exercise laboratory for 12 weeks for the class-based sessions, and were given a home-based walking and stretching programme. During the first four weeks they were closely supervised during these class-based sessions and supervision was minimal over the last eight weeks. Participants were taught initially to perform the exercises correctly and encouraged to apply maximal effort to each exercise. The exercise sessions were based on previous recommendations (Mazieres et al 2008, Roddy et al 2005, Zhang et al 2007), and consisted of a resistance-based circuit with eight stations. Participants spent 60 seconds at each station and had 30 seconds to move from one station to the next. They completed three circuits that took 36 minutes to complete with each circuit including use of an exercycle, cross trainer, leg press and calf press, and performance of knee extensions in sitting, sit to stand, a 20 centimetre step-up, and resisted hip abduction in standing. The resistance (load) was progressed on a station if the participant could comfortably complete more than 15 repetitions of the exercise in the allotted 60 seconds. The home-based activity programme was undertaken twice weekly and was based on the recommendations of Roddy et al (2005) and Zhang et al (2007). It consisted of a 20 minute walk and a stretching programme that included one 30 second stretch bilaterally for the quadriceps, gastrocnemius and hamstring muscles.

Action and Coping Planning Strategies (Intervention Group)

The development and implementation of the action and coping plans were based on those outlined by Sniehotta et al (2005). Intervention group participants completed the action and coping plans under the guidance of the researcher. They developed a realistic functional goal that they wanted to achieve by the end of the 12 week exercise programme, for example, to walk for 30 minutes without stopping. The participants and researcher then discussed how completion of the exercise programme would aid the achievement of this goal. The researcher assisted the participants individually with the completion of their planning forms. Participants completed an action plan that stated specifically when, where, how and with whom they were going to undertake the home-based walking, the home-based stretching, and class-based exercise programmes. Coping plans were based on the obstacles participants thought were likely to prevent them from attending the classes, and completing the stretching and walking programmes, for example *'I don't like walking in the rain'*. They then listed how they would overcome these anticipated obstacles by completing the sentence, *'I will overcome these obstacles by....'*. Participants who completed the action and coping plans, signed and dated the documents and were provided with a photocopy of their plan.

Procedure

Ethical approval for the study was obtained from the Northern Region 'Y' Ministry of Health Ethics Committee (NTY/09/01/001). Participants were recruited via advertising in a local paper and medical centres. Those who met the inclusion criteria and volunteered to participate were provided with verbal and written information about the study and signed a consent form. The components of the class-based exercise programme and home-based walking and stretching programmes were explained to all participants, and they were encouraged to attend three classes per week for 12 weeks. They then completed the questionnaires (PAR-Q, task, maintenance and recovery self-efficacy subscales) with the assistance of a trained research assistant and the functional measures (TUG, 6MWT, 10MWT, the Step Test and the LLTQ-ADL subscale) under the guidance of a second research assistant. Next the researcher instructed the intervention group participants about the development and use of the action and coping plans, and they were given a copy of these.

During the exercise programme, participants' class attendance was recorded at the beginning of each exercise class session, and participants completed the self-report scales for adherence to the home-based stretching and walking. At the end of each class one of the research assistants completed the SIRAS. At the

end of the 12 week programme participants repeated all the pre-exercise programme measures except for the PAR-Q. Those who withdrew from the programme (*n*=12) were contacted and in total, 25 participants completed the final set of questionnaires while 21 completed the physical measurements.

Data Analysis

Data were analysed using the Statistical Package for Social Sciences Version 16 (SPSS Inc., Chicago, IL, USA), with an alpha level set at 0.05. Data were screened for normal distribution, and mean scores, standard deviation and confidence intervals were calculated. Group equivalence on the demographic and OA characteristics and the pre-intervention measures were checked using independent *t*-tests and Chi-square tests. Cronbach alpha scores were calculated for each of the self-efficacy scales, the SIRAS, and the LLTQ-ADL subscale. When a significant difference occurred at baseline, a one-way analysis of covariance (ANCOVA) was used to determine the difference. The hypothesis that participants who received the action and coping plans would have higher levels of adherence and self-efficacy and better function following the exercise programme than those who did not, was tested using two group repeated measures analysis of variance (ANOVA) for the self-efficacy and function data, and one-way ANOVA and Chi-square tests for the adherence data. When significant differences occurred in the repeated measures ANOVAs then respective post-hoc independent and paired samples *t*-tests determined where these occurred. To test the hypothesised relationships between adherence and self-efficacy, adherence and post-study functional performance, and self-efficacy and post-study functional performance Pearson correlations were undertaken.

RESULTS

Demographic and Osteoarthritis Characteristics

The descriptive statistics and group comparisons for the demographic and OA characteristics are presented in Table 1. Thirty-six people expressed interest in taking part in the study; however, nine did not enter the study because they either did not meet the inclusion criteria (*n*=3) or choose not to enrol in the study (*n*=6). Twenty seven people took part in the study, with 17 in the intervention group and ten in the control group; the difference in group sizing was due to the computer-generated group randomisation. Fifteen of the participants who started the study completed the exercise programme (Figure 1) and where possible those who withdrew were followed up and asked to complete the final outcome measures. Six of the participants who dropped out of the study cited an increase in pain as the reason, with five of these specifically indicating that they felt the leg press machine was aggravating their symptoms. All of these participants had hip joint OA. The other participants who withdrew cited a lack of time (*n*=3), transport problems (*n*=1), work commitments (*n*=1) and other health concerns (*n*=1). Of note, there were no significant baseline measurement or group allocation differences between those who completed and those that did not complete the study. The only significant difference in the OA characteristics between the intervention group and the control group was the use of analgesics; however there was a trend (*p*= 0.059) towards a difference in duration since diagnosis of OA, with both scores being higher in the control group.

Adherence

There were no significant differences between the two groups in any of the adherence measures and their completion rate (Table 2). The attendance and programme completion rates were low for both groups, with approximately 50% of scheduled exercise sessions not being attended or programmes completed. The

Table 1: Descriptive and statistical comparison of the two groups' demographic and osteoarthritis characteristics

Variable	Intervention Group (*n*=17) mean (SD)	Control Group (*n*=10) mean (SD)	Statistic	Significance (*p* value)
Sex				
male	9	2	$\chi^2(1) = 2.83$	.09
female	8	8		
Age (years)	63.3 (SD 10.4)	63.7 (SD 11.3)	$t(25) = -.95$	.93
Currently employed	9	4	$\chi^2(3) = 1.27$	.53
Undertaken previous regular exercise	15	8	$\chi^2(1) = .34$	.56
Current exercise level (sessions per week)	3.5 (SD 1.5)	3.0 (SD 1.8)	$t(24) = .87$	.39
Joint affected				
hip	5	1	$\chi^2(2) = 2.84$	.24
knee	12	8		
both	0	1		
Duration since diagnosis of OA (months)	41.0 (SD 48.5)	76.7 (SD 47.7)	$t(25) = -1.98$	.06
Currently using analgesics	1	5	$\chi^2(1) = 7.09$	.01

Note. OA = Osteoarthritis, Gp = Group, SD=Standard Deviation.

Table 2: Descriptive and statistical comparisons of the two groups' adherence data

Adherence variable	Intervention Group (*n*=16) Mean (SD)	Control Group (*n*=9) Mean (SD)	Statistic	Significance (*p* value)
Classes attended (number out of 31 scheduled sessions)	17 (SD 11)	16 (SD 10)	*t*(24) = .24	.81
Class-based (SIRAS)	4.5 (SD 0.4)	4.6 (SD 0.9)	*t*(23) = -.65	.52
Home-based stretching	3.7 (SD 1.3)	3.9 (SD 0.2)	*t*(23) =-1.29	.21
Home-based walking	3.6 (SD 1.3) (*n*=17)	3.5 (SD 1.0) (*n*=10)	*t*(23) = .93	.93
Programme completion	10	5	c^2(1) = .20	.66

Note. SD=Standard Deviation, SIRAS = Sports Injury Rehabilitation Adherence Scale, the SIRAS / home-based stretching / home-based walking adherence scales were all rated on a 5 point likert scale where 1 equalled *'not at all'* and 5 equalled *'as advised'*, the variations seen in group sizes (i.e. *n*=16 changing to *n*=17) is due to some participants being lost to follow up measures.

Cronbach alpha for the SIRAS was acceptable (0.72). Their mean scores for the class- and home-based adherence were high, ranging from 3.5 to 4.6 out of a possible score of 5.

Self-Efficacy

Exercise Phase Specific Self-Efficacy

The exercise phase specific self-efficacy pre- and post-study mean scores were moderate to high at both time points (Table 3). The pre- and post-study Cronbach alpha scores for the three self-efficacy scales were high (task, 0.86; maintenance 0.88 and 0.91; recovery 0.90 and 0.92), except for post-study task self-efficacy which was 0.67. There was a significant difference between the groups for recovery self-efficacy, with an independent sample t-test revealing that it occurred between the groups' pre-study scores ($t(25) = 2.28$, $p < 0.033$, CI(95%) = 0.42-0.91), but not with the post-study scores $t(25) = 1.79$, $p = 0.089$, CI(95%) = -0.10-1.27). As the significant difference occurred at pre-study, a one-way ANCOVA was undertaken with no significant difference being found between the groups at the end of intervention ($F(1,18) = 0.31$, $p = 0.583$). There was a significant within-group difference for maintenance self-efficacy, and post-hoc paired sample t-test analyses comparing each groups' pre- and post-study maintenance self-efficacy showed a significant difference for the intervention group ($t(12) = 2.56$, $p < 0.025$, CI(95%) = 0.08 - 1.03), but not the control group ($t(7) = 1.06$, $p < 0.323$, CI(95%) = -0.38 - 1.00).

Functional Performance

The groups' mean scores for each functional test were similar at each of the measurement points with no significant differences occurring in the between-group analyses (Table 4). However, the within-groups analyses revealed significant differences in the 10MWT, step test, TUG and the LLTQ-ADL, but not in the 6MWT scores. Post-hoc paired sample *t*-test analyses revealed that significant differences occurred in the intervention group on the 10MWT, step-test, the TUG, and LLTQ-ADL, but only on the 10MWT for the control group (see Table 5). The pre-and post-study Cronbach alpha scores for the LLTQ-ADL subscale were acceptable (0.92 and 0.90).

Adherence, Self-Efficacy, Functional Performance Relationships

Amongst the three sets of relationships analysed, one significant correlation was identified that made conceptual and theoretical sense. This occurred between the SIRAS (adherence to the class-based exercise programme) and post-study LLTQ-ADL scores ($r = 0.51$, $p < 0.05$).

DISCUSSION

Our findings provided limited support for both hypotheses. For the first hypothesis the only notable significant difference between the two groups on the self-efficacy measures occurred for maintenance self-efficacy with a significant decrease in

Table 3: Descriptive statistics of the group comparison pre- and post-study and statistical comparison of the main mixed between- and within-group effect for phase specific self-efficacy subscales

	Pre-study		Post-study		Between-groups		Within-groups	
SE subscale	Intervention Group Mean (SD) (*n*=17)	Control Group Mean (SD) (*n*=10)	Intervention Group Mean (SD) (*n*=13)	Control Group Mean (SD) (*n*=8)	*F*(*df*=1,19)	Significance (*p* value)	*F*(*df*=1,19)	Significance (*p* value)
Task	3.39 (SD .55)	3.16 (SD .65)	3.60 (SD .34)	3.27 (SD .59)	1.70	.21	.05	.83
Maintenance	3.44 (SD .50)	3.00 (SD .66)	2.96 (SD .73)	3.81 (SD 1.03)	1.04	.32	5.82	.03
Recovery	3.51 (SD .59)	3.03 (SD .48)	3.46 (SD .59)	2.88 (SD .92)	6.66	.02	1.44	.24

Note. SE=Self-efficacy, Gp=Group, SD=Standard Deviation, df=Degrees of Freedom, Task / Maintenance / Recovery scales were all rated on a 4 point likert scale where 1 equalled *'strongly disagree'* and 4 equalled *'strongly agree'*, the variations seen in group sizes (i.e. *n*=17 changing to *n*=13) is due to some participants being lost to follow up.

Table 4: Descriptive statistics of the group comparison pre- and post-study and statistical comparison of the main mixed between- and within-group effect for functional performance scores

	Pre-study		Post-study		Between-groups			Within-in groups	
Functional performance	Intervention group mean (SD) (*n*=17)	Control group mean (SD) (*n*=10)	Intervention group mean (SD) (*n*=13)	Control group mean (SD) (*n*=6)		*F*(*df*=1,19)	Significance (*p* value)	*F*(*df*=1,19)	Significance (*p* value)
10MWT (Sec)	7.0 (SD 2.6)	6.8 (SD 2.2)	6.2 (SD 2.1)	5.5 (SD 1.4)	.88	.88	.36	10.21	.01
Step test (Reps)	7.4 (SD 2.4)	7.5 (SD 2.1)	9.4 (SD 1.6)	9.5 (SD 2.1)	.67	.67	.42	17.22	.00
6MWT (Meters)	475 (SD 130)	459 (SD 171)	465 (SD 171)	499 (SD 91)	.53	.53	.48	.12	.73
TUG (Sec)	9.0 (SD 3.6)	7.9 (SD 2.8)	7.4 (SD 2.8)	6.6 (SD 1.6)	1.37	1.37	.26	6.33	.02
LLTQ-ADL	28.2 (SD 8.4)	29.0 (SD 8.1)	32.2 (SD 6.0)	27.8 (SD 8.4)	.30	.30	.59	1.83	.94

Note. 10MWT = 10 meter walk test, 6MWT = 6 minute walk test, TUG = timed up and go test, LLTQ-ADL = Lower limb task questionnaire activities of daily living subscale, SD=Standard Deviation, *df*=Degrees of Freedom, the variations seen in group sizes (i.e. *n*=17 changing to *n*=13) is due to some participants being lost to follow up

Table 5: Within group post-hoc t-test statistical comparison of function

Functional Measures	Statistic	CI (95%)	Significance
10MWT (Sec)			
Intervention (*n*=13)	*t*(12) = 3.27	.36 - 1.83	*p* < .01
Control (*n*=6)	*t*(5) = 3.02	.08 - 1.02	*p* < .03
Step test (Reps)			
Intervention (*n*=13)	*t*(12) = -4.76	-3.25 - -1.21	*p* < .00
Control (*n*=6)	*t*(5) =-1.94	-2.33 - 0.33	*p* =.11
TUG (Sec)			
Intervention (*n*=13)	*t*(12) = 3.48	.73 - 3.17	*p* < .01
Control (*n*=6)	*t*(5) =.77	-.47 - 0.87	*p* = .48
6MWT (Meters)			
Intervention (*n*=13)	*t*(12) = .03	-86.50 - 89.27	*p* =.97
Control (*n*=6)	*t*(5) = .96	-33.41 - 73.41	*p* =.38
LLTQ-ADL			
Intervention (*n* =13)	*t*(12) = -3.27	-6.54 - -1.31	*p* < .01
Control (*n* =13)	*t*(7) =.786	-2.54 - 5.04	*p* = .46

Note: 10MWT = 10 meter walk test, 6MWT = 6 minute walk test, TUG = timed up and go test, LLTQ-ADL = Lower limb task questionnaire activities of daily living subscale, Sec = Seconds, Reps = Repetitions.

these scores for the intervention group over the duration of the study. Despite there being no significant differences between the groups on their pre- and post-intervention functional activity scores, there were significant within group differences. The intervention group showed significant differences on the 10MWT, step test, TUG and the LLTQ-ADL, whereas the only significant difference for the control group was on the 10MWT. The limited support for the second hypothesis came from the moderate strength significant correlation in the expected direction between the class-based adherence and post-study functional outcomes. Over and above these general observations there are a number of factors related to the study, its findings and the feasibility of the protocols that merit discussion.

Contrary to previous research showing that action and coping plans have a positive effect on adherence to exercise programmes (Luszczynska 2006, Scholz et al 2005), the findings of our study were not completely in favour of this notion. This may have been due to the characteristics of the programme, the measures used and the sample size. The 12 week duration of the exercise programme and the need to attend the class for up to three times per week may have been a deterrent to the participants. Prior to the commencement of the programme potential participants were informed about the commitments of the programme, leading to six people declining to participate because they could not commit to the programme requirements. By the end of the programme the attendance

rates of both groups was less than desirable, at approximately 50%. Given that adherence to long-term exercise programmes is known to diminish over time (Lombard et al 1995), the 12 week duration of the programme may have contributed to the poor level of attendance (Rejeski et al 1997). In addition, six participants withdrew because the exercises increased their pain; exercise-related pain has previously been shown to reduce exercise adherence (Rejeski et al 1997).

The non-significant result between the two groups' class- and home-based adherence may have been due to a ceiling effect in the scores. The groups' mean scores for adherence to the class-based (SIRAS) and home-based activities were moderate to high, ranging from 3.4 to 4.6 out of a possible 5. These high scores may be due to the SIRAS only consisting of three items, meaning it is not able to capture all of the class-based adherence related patient behaviours. In a recent study, the SIRAS was reported to have limited sensitivity (Granquist et al 2010). One reason for the high home adherence self-report measure scores may have been due to participants over-estimating their level of adherence, which has been reported in other research (Pisters et al 2010a). Nonetheless, participants may have high levels of home-based exercise adherence because of the easy accessibility to the activities, which has been shown in previous research (Bassett and Prapavessis 2007).

The only noteworthy self-efficacy finding was a significant decrease in the intervention group's maintenance self-efficacy over the duration of the study, which is contradictory to other research (Luszczynska 2006, Scholz et al 2005). A possible reason could be that the self-efficacy measures were completed at the beginning of the study when the participants had a limited awareness of the demands of the exercise programme, which may have led to them underestimating the influence of the barriers to exercise over the duration of the programme. This decrease could therefore be regarded as an adjustment to the "accuracy" of the participants' beliefs regarding their ability to exercise regularly. This unexpected decrease in self-efficacy scores over the duration of the exercise programme is not new and has been described in other health-related exercise programmes (Morgan et al 2010).

The significant differences in the two groups' functional performance findings could be due to three possible reasons. First, improvements could be attributed to the effect of the prescribed exercises, as found in similar exercise programmes (Jan et al 2009, Mikesky et al 2006). Second, the action and coping plans may have to some extent been responsible for the intervention group's functional improvements over the duration of the study by focussing this group's attention on the exercises and overcoming the barriers to exercise and attending the exercise classes (Sniehotta et al 2005). Similarly, Ziegelmann et al (2007) found providing a plan for participation in exercise (implementation intentions) resulted in better engagement in the exercise programme than simple goal setting. Third, the lack of the control group's change in function over the duration of the programme may have been due to significantly more participants in the control group being on analgesic medication and the trend towards this group having a longer duration of symptoms before starting the study. Longer symptom duration has been linked to poor response to exercise in people with OA (Wright et al 2009), which in turn may explain their reduced functional improvement.

The significant correlation between adherence (SIRAS) and post-study perceived function (LLTQ-ADL) adds to existing knowledge, by further strengthening the notion that high levels of treatment adherence are associated with optimal functional recovery. Previous research has documented associations between high levels of rehabilitation adherence and functional recovery (Bassett and Prapavessis 2011, Brewer et al 2000a).

There are a number of recommendations for future research into exercise programmes and the use of adherence enhancing strategies that have come to light as a consequence of conducting this feasibility study. Five recommendations involve improvements to the design and implementation of future similar studies. Three of these recommendations relate to procedural aspects of study: the timing of the measurement of participants' self-efficacy beliefs, the balance of the home- and class-based exercises, and the removal of exercises that produce joint pain. Firstly, the measurement of the participants' self-efficacy beliefs would have been better done at the end of the participants first week of exercises, instead of before commencing the exercises. This would have allowed the participants to have a more accurate understanding of the prescribed exercises, and may have limited the possibility of over-estimating self-efficacy beliefs. Secondly, the balance of the class- and home-based components of the exercise programme could be adjusted, as the results indicated that the participants, irrespective of their grouping, found it easier to adhere to home-based exercises than the class-based exercises. Similar results have been found by other researchers (Bassett and Prapavessis 2011, Johansson et al 2009); therefore, it would be appropriate for a greater emphasis on home-based exercises in future studies. Finally, in light of the number of the participants (n = 5) with OA who dropped out of the study because of the pain experienced with the leg press exercise, future studies could look to excluding this exercise for participants who experience similar problems. This recommendation is in keeping with that of Allegrante and Marks (2003).

The two measurement tool factors that could be changed to improve the design of future studies include the use of home-based adherence measures with a larger range of Likert scale responses, and the use of a more reliable measure of class-based adherence. Using a rating scale of one to seven, versus one to five, may reduce the likelihood of a ceiling effect with the measurement scale (Hessing et al, 2004). A ceiling effect occurs when a measure possesses a distinct upper limit for potential responses and a large concentration of participants score at or near this limit. The scale is therefore unable to differentiate between changes in the recorded phenomenon. Since the design and implementation of this study, a new measure of class-based adherence has been developed which has been shown to be a more reliable and valid measure of class-based adherence than the SIRAS (Granquist et al 2010). Future studies may find class-based adherence would be better assessed by the recently developed 16 item Rehabilitation Adherence Measure for Athletic Training (Granquist et al 2010).

In spite of its limitations, this feasibility study did provide a preliminary insight into the use of action and coping plans as adjuncts to exercise programmes for future research and clinical practice. Given the findings of previous research that has shown action and coping plans are effective in encouraging exercise

behaviours (Luszczynska 2006, Scholz et al 2005, Sniehotta et al 2005), physiotherapists should consider using these with patients who are having problems incorporating exercises into their daily routines.

CONCLUSION

Contrary to our expectations, exercise adherence was not significantly improved by the use of action and coping plans, which may in part be due to limitations with the adherence measures used. Nonetheless, the group that implemented the action and coping plans did have a significant improvement in four of the five functional outcomes which may have been due to them focussing on the exercises and overcoming the barriers. Further the moderate to strong adherence – post-treatment relationship adds further weight to the notion that high levels of adherence are important for optimal treatment outcomes. Finally, the true value of incorporating action and coping plans into exercise programmes for people with lower limb OA will only be ascertained by a larger investigation that includes the methodological recommendations we have identified.

KEY POINTS

- Action and coping plans as an adjunct to exercise programmes may improve functional performance
- Action and coping plans did not influence adherence or self-efficacy
- Future research should be mindful of the procedural recommendations made in this feasibility study
- Relationships exist between exercise adherence and post-treatment functional outcomes

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Perceptions by physiotherapy students and faculty staff of a multimedia learning resource for musculoskeletal practical skills teaching

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ABSTRACT

The aims of this study were to develop a multimedia DVD for musculoskeletal skills within a School of Physiotherapy, and explore faculty staff and students' perceptions of its usefulness and effectiveness. Faculty staff were consulted regarding the resource's content, audio-video clips of manual skills were filmed, and agglomerated in DVD-format. All Year 2 physiotherapy students received a copy of the media. Perceptions of usefulness and effectiveness of the resource were determined with a questionnaire (for students) and focus groups (for faculty staff and students). Quantitative data were analysed with descriptive statistics and the General Inductive Approach was used for qualitative data. Students responded favourably to the DVD with medians from the questionnaire ranging from 1.1 to 1.6 on a Likert Scale (1 most positive, 5 least positive). Qualitative analysis identified four categories: DVD usefulness, learning styles, effects on teaching, and DVD application. While faculty staff did not observe improvements in practical skills during clinical placements, students reported using the DVD primarily for revision purposes and that their confidence for the application of the skills had increased. In general, the DVD was perceived to be useful as an adjunct to traditional laboratory teaching.

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Key words: physiotherapy education, multimedia resource, musculoskeletal physiotherapy, manual techniques.

INTRODUCTION

The acquisition and mastery of practical manual skills is important for physiotherapy students to ensure effective assessment and treatment of patients with musculoskeletal disorders (Bowley and Holey 2009, Sizer et al 2007). Besides mechanical application of techniques, manual therapy competency also includes the development of discriminant touch and fine manual sensorimotor feedback (Sizer et al 2007). Development of these skills requires initial practice on healthy individuals to gauge a sense of normal, followed by clinical practice on individuals with musculoskeletal pathologies to develop the ability to discriminate abnormal findings (Bowley and Holey 2009). From a motor learning perspective, repeated rehearsal of manual therapy skills, feedback and experience are needed for competent and safe performance of these techniques (Triano et al 2012).

The four-year baccalaureate degree in physiotherapy at the University of Otago, New Zealand, has an intake of up to 120 students per year. Manual techniques are conventionally taught in class laboratories, mainly in Years 2 and 3 of the physiotherapy programme, in groups of approximately 30 students with instruction often given by different tutors. Despite weekly preparatory meetings between tutors and the paper coordinator, anecdotal reports from students suggest consistency of teaching between tutors and laboratory groups could be improved. Similarly, there are perceived inconsistencies in teaching and implementation of manual skills between the laboratory and clinical environments, as educators supervising students in clinical practice are not always involved in the academic laboratories, and vice versa. To promote student learning, it is important for each person involved in teaching (i.e., laboratory tutors and clinical educators) to be aware of others' methods and to support students to transfer the skills and knowledge between the two teaching settings. Having a standard reference for all education personnel could potentially increase the consistency and clinical application of skills.

Many resources can be utilised as adjuncts to teaching physiotherapy skills. Besides the use of textbooks, multimedia such as DVDs and videos have been used successfully as resources to complement traditional teaching in medical,

nursing and physiotherapy curricula (Brydges et al 2010, Erickson 2004, Kelly et al 2009, Khogali et al 2011, Maloney et al 2013b, Rowe et al 2012). Maloney et al (2013b) showed that physiotherapy students who had access to video tutorials rated the learning experience higher than those in the group receiving traditional teaching only, while no significant between-group differences were found in formal examinations. This perceived increase in educational value may occur for various reasons, i.e., access to these resources allows increased autonomy, self-responsibility for learning, and a greater ability to self-pace or self-regulate learning (Brydges et al 2009, Kelly et al 2009). Based on this trend towards greater self-responsibility of learning and the inclusion of multimedia in health sciences, the aim of this project was two-fold. The first aim was to develop a DVD resource to complement undergraduate Year 2 manual skill acquisition in musculoskeletal laboratories of the University of Otago physiotherapy programme. The second objective was to determine the perceptions of usefulness and effectiveness of the DVD from faculty staff and students that used this resource.

METHODS

Development of the multimedia resource

The resource developed for use in this study was in DVD format and comprised audio-video clips of standardised manual physiotherapy techniques. Prior to the development of the resource, two focus group interviews and informal discussions were held to prioritise and structure the DVD content with faculty staff at our School. This group comprised clinical educators, lecturers and laboratory tutors. After a majority consensus was achieved for the content, filming and formatting of the audio-video clips were undertaken using volunteers consisting of three physiotherapists acting as demonstrators and several physiotherapy students (four males, four females) acting as models. Written informed consent was gained from all volunteers before filming of the clips, as was approval from the University of Otago Human Ethics Committee for the entire research project.

Following a 3-week filming period, the series of manual skill-based audio video-clips were edited and formatted to DVD. A copy of the developed DVD was provided to all Year 2 laboratory tutors and students in our physiotherapy programme. The DVD was incorporated into the second half of a 13-week semester within the 2010 academic year.

Evaluation of the multimedia resource

Procedures

Data were collected through two mediums: (1) administration of an evaluation questionnaire, and (2) facilitation of focus group interviews.

Evaluation questionnaire

An evaluation questionnaire pertaining to the DVD was designed with the assistance the Higher Education Development Centre (HEDC) at the University. The questionnaire, in the form of a survey, was administered to all enrolled physiotherapy students in Year 2 (n = 109) during a laboratory at the end of the second 13-week teaching semester in October, prior to the formal 2010 academic year examination processes. The questionnaire consisted of nine closed-questions measured on a 5-point Likert scale (ranging from 1 to 5, where 1 designated the most favourable response and 5 the least favourable, Table 1). It also included the following open-ended question: "Do you have any additional comments relating to any aspect of the DVD?". Students were informed of the purpose of the questionnaire, which was then completed voluntarily, indicative of consent to participate.

Focus group interviews

Two distinct focus group interviews were held. The student focus group was performed after the academic examinations in November 2010, and the staff focus group in December 2010. The student interviews were semi-structured, following the outline provided in Table 2, and targeted between 8 to 16 participants. No specific order of questioning was followed during the interview process; however, more time was allocated to some questions than others depending on the information provided by interviewees. All participants involved in the focus groups were volunteers and provided verbal and written informed consent prior to participation. The same experienced researcher conducted both focus group sessions (MP), and had not previously been involved in teaching the Year 2 physiotherapy students. The two interviews were recorded with a digital voice recorder for later analysis.

Participants

A total of 81 (74%) Year 2 physiotherapy students from the 2010 cohort completed the questionnaire, with 15 of them attending the focus group in November (6 males, 9 females; mean (SD) age, 20 (1) years). A total of 9 faculty staff (7 males, 2 females; professional experience range, 2 to 31 years) participated in the December focus group. Eight of the faculty staff were employed as professional practice fellows, with responsibilities for laboratory tutoring and/or clinical education, and one was a lecturer, with responsibilities for coordination of papers and presentation of lectures and laboratories.

Data management, processing and analyses

Counts and medians for the Likert scales for the students' nine closed questions were computed by HEDC using customised software. Responses to the open-ended question from the evaluation questionnaire were transposed verbatim in anonymous format into a word processor for qualitative assessment, as were the two digital voice recordings from the focus group interviews. Quotes from specific individuals were labelled as "student" or "staff" together with an identification number. To distinguish questionnaire data from focus group data, the former were labelled with "HEDCq". Furthermore; dashes (—) were used to indicate pauses, ellipses (…) to indicate removal of text that did not interfere with data interpretation, and brackets [ ] to denote information added from investigators to clarify data.

The General Inductive Approach (Thomas 2006) was used to analyse the transcribed data. Two investigators independently read the transcribed data multiple times to identify recurrent themes. Through an independent iterative process, the

Table 1: Outcome of the student evaluation questionnaire for the DVD

	Question	Responses as percentage of all responders*					Median
		1	2	3	4	5	
1	How well structured have you found the material on this DVD?	78	19	2	0	0	1.1
2	How well are the techniques demonstrated on this DVD?	59	40	1	0	0	1.3
3	How clearly are the techniques described verbally on this DVD?	56	38	6	0	0	1.4
4	How effective have you found this DVD in helping you to prepare for your lab sessions?	64	30	5	1	0	1.3
5	How effective have you found this DVD in helping you to revise techniques following lab sessions?	84	16	0	0	0	1.1
6	How would you rate the quality of the video?	44	48	7	0	0	1.6
7	How would you rate the quality of the audio?	46	42	10	2	0	1.6
8	How would you rate the quality of the graphics?	47	42	11	0	0	1.6
9	Overall how well produced is the DVD?	49	47	2	0	0	1.5

* Most favourable response: 1; least favourable response: 5

Table 2: Schedule of semi-structured interview questions

Generic questions
• What did you think about the finished DVD?
• In what ways have you used the DVD?
• Has the DVD changed your method of learning/teaching of this course?
• How has the DVD helped/supported your learning/ teaching (in relation to lab and lecture teaching)?
• Any further recommendations/thoughts about this DVD or future DVDs?
Student specific questions
• Has the DVD changed the way that you work/practise and/or collaborate with classmates (peer support etc)?
• In what ways have you been able to apply these techniques to other learning situations this year?
• How would you envisage using the DVD in the future?
• What would make the resource more useful?
• What else would you like included on the DVD?
• Would other resources such as this DVD be of use in other papers?
Faculty staff specific questions
• Has the presence/provision of the DVD required extra work from you? How?
• How has the DVD changed the way the students approach (learning/interaction with classmates/clinical placements)
• What would make this specific DVD a more useful resource for you as a teaching tool?

investigators classified important or common concepts into categories. The categories that emerged from this parallel coding were then compared, discussed, and refined (Thomas 2006). Once consensus had been reached, the defined categories were cross-referenced to the original data to verify that these were indeed representative of the data. The computer programme NVivo 8 (QSR 2009) was used to assist in the thematic organisation of data. Excerpts from the transcribed data are presented to depict concepts inherent in each main category and are reported alongside the study findings.

RESULTS

Results for the questionnaire indicate median scores ranging from 1.1 to 1.6 on the 5-point Likert Scale (Table 1). Over 94% of respondents rated the content of the DVD favourably in terms of demonstration of techniques (Question 2) and revision following laboratory sessions (Question 5). The audio, video, graphics and overall production quality of the resource also were favourably rated, with medians of 1.5 or 1.6 (Questions 6 to 9).

Four main categories were identified from the qualitative analysis, with each category encompassing perceptions from students and faculty staff on given aspects. The categories were: DVD usefulness, learning styles, effects on teaching, and DVD applications. 'DVD usefulness' describes perceptions of outcomes resulting from use of the DVD for teaching, education, or learning. 'Learning styles' were perceptions of how the DVD could or did cater for particular learning styles, such as facilitating retention of information in visual learners. 'Effects on teaching' relates to perceived effects on teaching within the laboratory setting, and 'DVD applications' were the perceptions and/or contexts surrounding the use of the DVD.

DVD usefulness

The majority of the students perceived the DVD positively:

> *"DVD's of techniques are fantastic…more!"* (HEDCq)

Similarly, staff also perceived that the students appreciated the DVD:

> *"I had feedback from the students…I think that's probably the most important.…The students were very positive"* (Staff 1)

Students thought that their confidence for performing the techniques had increased, particularly when applying them on their peers:

> *"It was really good to know that I was doing it right and was not going to harm them. It gave me quite a bit of confidence."* (Student 4)

However, staff members were yet to see a difference in student confidence and performance during clinical practice:

> *"To be able to definitely say "Yes, there is a difference in their techniques or they are much more confident coming to the clinic now...", I think it's…too early…to make that statement."* (Staff 4)
>
> *"For some of the students, it did help to motivate their learning."* (Staff 1)

Clinical staff perceived that the DVD was useful for improving their own understanding of what students had been taught and for extending their technical skills in the clinical environment:

> *"I think as a clinician…it's actually quite nice for me to have seen …how they've been taught so that when they come along to the clinic I know…how it's been done."* (Staff 5)

In addition staff could envision using the DVD in other useful ways:

> *"I think* [the DVD] *would be useful for clinicians, and for your down time with your students. You could use it as a discussion tool to go through and practise things and perhaps develop that to the next stage."* (Staff 7)

Learning styles

Both students and staff recognised that the DVD provided a different medium to prepare and learn from and may be particularly appealing to visual learners:

> *"You…go to the lab and you see what's happening...and then if you go home and read a textbook, they're not the same…Whereas actually seeing it, you actually visualise what you are supposed to be doing and what you are testing and how it's all working…I don't know, rehab just seems to be a physical and visual subject, and therefore it needs a physical and visual medium to teach it."* (Student 15)
>
> *"It's…much easier for people to watch a resource rather than…read a resource."* (Staff 3)

However, one student commented that just watching the DVD would not be enough and that hands-on practise with another student was still important for learning the manual techniques:

> *"It's still a practical course. You still have to practice it at some point. You can't just watch only the DVD and never practise and still be able to do the techniques."* (Student 8)

Effects on teaching

Students and staff recognised that the DVD provided consistency between staff teaching the techniques in various laboratories:

> *"It's good to sort of unite what we are learning, cause we are in different groups and we do have different instructors…we are not starting off in a variation…we are all starting off at the same point."* (Student 3)
>
> *"It's almost like a calibration tool to make sure that everybody is on the same page."* (Staff 2)

However, while staff attempted to use the laboratory time for showing variations in techniques and to provide underlying context to use of techniques, it was perceived that the DVD may have potentially hindered the incorporation of modified techniques into teaching and student practice sessions:

> *"The detriment…is that often, they* [students] *would completely ignore all the modifications and everything else that was going on in the lab* [laboratory]*…they would go back to learning and reproducing the DVD version of the technique."* (Staff 1)

This staff member's comment was verified by some students, who found discrepancies between demonstrations of techniques between the DVD and lab tutors confusing. In addition, other students had been disappointed when staff appeared unsure of the DVD content and questioned a particular technique:

> *"Sometimes confusing when a technique is done differently in the lab compared to the DVD."* (HEDCq)
>
> *"Our lab demonstrator would say sometimes, "I'm not sure how this is shown on the DVD" and then would continue on to do however he did it. It would have been nice if maybe he did know how it was shown on the DVD."* (Student 9)

Conversely, other students enjoyed seeing the different methods of performing the same techniques as they perceived it increased their ability to individualise the technique to different patients or individuals:

> *"DVD was good to use to see different methods of doing technique rather than just lab tutors."* (HEDCq)

DVD applications

Some students found the resource helpful for pre-laboratory preparation:

> *"I did watch it before the lab and I thought it was really useful for practice."* (Student 3)

However, many students did not practise prior to the laboratory sessions for a variety of reasons, but mostly due to perceived time constraints:

> *"I didn't have time really. Too lazy, really. To be honest."* (Student 4)
>
> *"We do a lot of contact time in class and organise other things, and we also got sports and other commitments as well. It's pretty hard without them asking us to do prep before labs as well… if we do that, we give up all the other spare time we've got."* (Student 15)

Staff also noted that many students did not use the DVD for laboratory preparation:

"The DVDs are meant to be watched by the students before they come to the labs, so they are used as preparation. So myself, as a lab tutor then brings in… context, modification…and why you would modify it, what the technique means, a positive and negative test et cetera." (Staff 1)

Assigning specific tasks was one method for encouraging preparation:

"The first time I said "Watch the DVD, next week we are doing the hip or the knee". So they came, and I said "okay, so you all watched the DVD, can any of you show me [a specific technique]*", and then they all looked at me blankly. But when I said "I want…your group to prepare and have a look at this technique",…that worked."* (Staff 1)

Students mainly used the DVD as a reference tool for revision after laboratories, catching up after missing these classes, and preparing for formal examinations:

"It was good to be able to go over the stuff in labs and then watch it back, after the labs." (Student 6)

"If you've previously missed a lab, it's really good." (Student 15)

"Perfect for exam study." (HEDCq)

However, one staff member perceived that students used the DVD to cram and another felt that, while students might do well in examinations with the DVD, so far, students had not shown improved ability to transfer the techniques into clinical practice:

"Well, what they did tell me at the end of the semester [was that] *they would cram with the DVD."* (Staff 1)

"Whether it [the DVD] *makes any difference to their ability to treat patients or to manage a patient situation, I'm a little sceptical. Whether it gives them the ability to pass their practical exam at the end of 254* [PHTY254, the University code for the paper Physiotherapy Rehabilitation Science], *working with a normal model, it probably will."* (Staff 2)

Some students thought that the DVD would be useful for revision prior to laboratories and clinical placement in the following academic year (Year 3):

"Preparing someone for going into say, Year 3 so we've got it 'down pat'…say before we move on to harder things. Definitely. Definitely." (Student 5)

"I would use it to prepare before physiotherapy [clinical] practice." (HEDCq)

DISCUSSION

The results indicate that the DVD was perceived to be useful by students and academic staff as an adjunct to traditional laboratory teaching. Based on student responses to the evaluation questionnaire, the resource was of high to very high video, audio, and graphical quality, and perceived to be well structured, demonstrated, and produced. End-users' evaluations of the resource suggest that the DVD was useful in increasing consistency amongst personnel involved in laboratory teaching, providing an additional or alternative learning tool, revising material covered in laboratory, and preparing for end-of-year assessment procedures. Despite these positive perceptions, the resource was not consistently employed by students for laboratory preparation or self-directed learning, or across faculty staff.

Based on the favourable scores from the DVD evaluation questionnaire and the perceptions sourced from qualitative interviews, students regarded the DVD as a valuable and beneficial addition to their education experience and suggested that similar resources be developed for the subsequent year of their physiotherapy programme. These findings concur with previous studies indicating that the addition of multimedia learning resources were highly appreciated by students in health sciences (Khogali et al 2011, Maloney et al 2013b, Veneri 2011). Although faculty staff suggested that the use of the multimedia resource was unlikely to significantly influence formal examination scores, as shown by Maloney et al (2013b), the comments from the students suggest that their learning experience was more favourably regarded with, rather than without, the use of audio-video material.

An important finding of this study was that students perceived that they had increased confidence with application of the manual skills within the laboratory and in clinical practice after using the DVD. This attribute is vital for reasoning and interaction with others (Eva et al 2012), and our findings agree with those of Maloney et al (2013a) that the addition of multimedia resources is associated with improved student confidence. The affective component is an important factor for the learning experience (Sadideen and Kneebone 2012), and it is possible that the self-regulated access to the resource contributed towards the perceived improved confidence.

Despite the students' perception of increased confidence with applying the practical skills, faculty staff suggested that students did not appear to demonstrate any greater ability to translate their taught skills to clinical practice compared to previous cohorts who were not exposed to the DVD resource. However, we cannot corroborate or refute these perceptions because this study did not aim to compare examination scores from students with or without access to the multimedia resource. To date, the literature on the effect of multimedia resources on student examination scores provides equivocal findings. Studies involving physiotherapy (Smith et al 1996, Smith et al 2006) and medical (Brydges et al 2009) students have found a greater retention of ankle assessment and surgical skills when students had access to CD or video instructions, respectively, than those students who did not. Elsewhere, a randomised clinical trial with undergraduate physiotherapy students found no significant difference in clinical examination outcomes between undergraduate physiotherapy students who were taught using traditional practical teaching versus video tutorials and self-videos (Maloney et al 2013b). In the current study, the limited timeframe after introduction of the DVD to when the faculty staff were interviewed is likely to have contributed to the staff perceptions that students did not show clear improvements in their ability to apply manual skills. Future studies could investigate whether students in the same physiotherapy year demonstrate different assessment scores in formal end-of-year examinations with and without exposure to the DVD resource.

The content of the new DVD primarily focussed on the mechanical component of skill acquisition, and therefore could

also explain why faculty staff perceived that student application of techniques were not improved with the addition of the DVD resource. Application of manual techniques in physiotherapy practice needs to be adapted and is context-dependent. For instance, clinicians are required to modify techniques upon individual presentation with given symptoms or co-morbidities (Sizer et al 2007, Triano et al 2012). Communication and clinical reasoning skills, refining discriminate touch, bilateral hand-eye coordination, and the clinician's manual gross sensorimotor characteristics are examples of components that contribute towards effective management of an individual with a musculoskeletal disorder (Jones et al 2008, Sizer et al 2007). For a multimedia resource to better prepare students to the situations encountered in daily clinical practice, the resource may need to present several alternatives or modifications to each technique to respond to common clinical presentations and requirements. This has been achieved previously by relating techniques to cases from professional experience (Duvivier et al 2009, Sadideen and Kneebone 2012) and research evidence that underpins the use of the skills in practical settings (Maloney et al 2012b, Triano et al 2012, Zipp and Maher 2010). Alternatively, if the clinical educator has an understanding of the content of the resource, they could facilitate the student's reasoning processes to modify the techniques to the individual patient or client's requirements.

While the findings suggest that faculty staff found the resource useful, concerns were also raised that students were not using the DVD towards laboratory preparation. Whilst it is accepted that students should be challenged to take more responsibility for their learning, a generic framework should be provided to ensure that learning is appropriate, particularly in the early years of learning (Miflin et al 1999). The DVD was purposefully introduced to the laboratories half-way through the programme to allow comparisons by the students of their experience with and without the resource. As preparation for laboratories was not continually emphasised at the beginning of the programme, this may have affected staff and students' expectations once the DVD was available. The expected learning framework will need to be made more explicit from the outset of future programmes and support for this approach would need to be acquired from all staff involved with teaching.

Many comments sourced from the end-users' evaluations of the multimedia resource indicated that that DVD was perceived as useful and beneficial particularly to visual learners. Learning outcomes are thought to be enhanced by attention being paid to students' different learning styles (Sadideen and Kneebone 2012), and it is likely that the DVD met this need for several of our physiotherapy students. However, this is speculative considering that neither predominant learning style nor performance scores were determined in the current cohort of physiotherapy students. Previous research has shown that while an interactive DVD significantly improved grades awarded to students conducting a clinical examination of the ankle, individual learning styles did not significantly contribute to this improvement (Smith et al 2006). Accordingly, although students and faculty staff perceived that the DVD assisted visual learners in the current study, the actual effects of the DVD on individual assessment scores remain undetermined.

Study limitations and strengths

Although all Year 2 students had the opportunity to complete the quantitative questionnaire, the qualitative interview was limited to a small number of volunteers. It is possible that those with positive experiences and perceptions were more likely to complete the questionnaire and volunteer for the interview, which could bias the results. However, as the qualitative results appear to match those of the questionnaire, the likelihood of such bias is potentially small. The strength of this study is that a mixed-methods design was used, which includes quantitative and qualitative data. This allowed comprehensive analysis of results from different angles, in addition to incorporating both student and faculty staff feedback.

CONCLUSION

Multimedia learning is an established means of facilitating learning in health sciences curricula and provides students with the ability to access resources in a flexible manner. Students and faculty staff generally considered the implementation of the DVD resource to be useful providing an additional method of learning manual skills (particularly for students preferring visual resources) and enabling some consistency between faculty staff teaching laboratories. While faculty staff did not perceive clinical performance of the students to have improved, students reported having increased confidence when performing the skills. Only a limited number of the enrolled students appeared to use the DVD for laboratory preparation, with the majority of students primarily using it for revision and preparation for formal examinations. Although faculty staff noted positive outcomes from incorporating the DVD into teaching, use of the DVD was inconsistent amongst staff and they were concerned that some students appeared reluctant to modify skills to individual requirements. Emphasizing the importance and potential benefits of using the DVD in preparation to laboratories, rather than only in revision, may increase the future value and effectiveness of the resource in teaching manual skills.

KEY POINTS

- Students valued the multi-media DVD resource with manual therapy techniques highly, providing a resource they could access externally to formal teaching sessions, reporting increased confidence for the application of the manual skills.
- While use of a DVD may result in greater consistency of teaching between laboratory groups, there was also concern from faculty staff that some students appeared reluctant to modify techniques as required in clinical practice.
- A framework may need to be provided for students and faculty staff for the optimal use of the DVD to supplement formal teaching sessions.

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Physiotherapy management of complex regional pain syndrome

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ABSTRACT

Complex Regional Pain Syndrome is a painful debilitating condition characterised by sensory, vasomotor, sudomotor, and trophic changes. Traditionally, physiotherapy treatments have been directed at peripheral symptoms, often with limited efficacy. In light of the growing scientific evidence promoting the major role of the central nervous system in the pathogenesis of Complex Regional Pain Syndrome, there has been a shift towards interventions considered to modulate central processing. A systematic review performed in 2009 aimed to assess the evidence regarding the physiotherapy management of Complex Regional Pain Syndrome. Techniques showing some promise include mirror therapy, Graded Motor Imagery, tactile discrimination training, and exposure therapy. This paper aims to elaborate on the scientific framework for these techniques and explore the current research regarding treatment efficacy. Hopefully, further wide dissemination of these ideas will spark more interest from clinical practitioners and clinicians alike in the quest to more completely understand and manage this complex condition.

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Key Words: Body perception disturbance, Graded Motor Imagery, mirror therapy, tactile discrimination training, exposure therapy.

INTRODUCTION

Most physiotherapists either have encountered, or will encounter, a challenging case of Complex Regional Pain Syndrome (CRPS), often, but not necessarily following a patient's injury, myocardial infarction, or stroke (De Mos 2007, Veldman 1993). Traditionally, physiotherapy treatments have focussed mostly on attempted modification or management of peripheral symptoms, often with limited efficacy. More recently, spurred by scientific advances identifying the significant role of the central nervous system in the pathogenesis of CRPS, techniques which focus on central processes have been developed (Moseley 2010). Treatment strategies including mirror therapy, Graded Motor Imagery, tactile discrimination training and exposure therapy have been explored in one guise or another. However, there is little in the literature as to how these worlds of scientific evidence and best clinical practice come together. This paper addresses and attempts to bridge this divide, reviewing the scientific research that informs our adoption of these novel treatment techniques.

Diagnostic Criteria and Pathophysiology

The clinical features of CRPS include burning pain, allodynia (pain from a non-painful stimulus) and hyperalgesia (increased response to a painful stimulus); motor disturbances ranging from decreased range, speed, co-ordination of movement, tremor and muscle spasms; changes in vascular tone, temperature, skin colour, sweating and oedema; trophic changes to skin, hair, nails and perceptual disturbances with distortions to the body-self (Harden and Bruehl 2006, Lewis and McCabe 2010).

There are two types of CRPS described: CRPS-1 can occur spontaneously or following trauma, with the symptoms unrelated to the region of a single nerve, and disproportionate to the inciting event. CRPS-2 occurs in association with nerve damage (Merskey and Bogduk 1994). The management of these are similar; however, it is important to identify the presence of nerve injury in case further intervention is warranted.

The exact cause of CRPS is still not fully understood, however there are a number of proposed pathophysiological mechanisms which contribute to the overall symptoms. Neurogenic inflammation, which involves the amplification of cytokines, bradykinins, endothelin, neuropeptide CGRP and Substance P, has been demonstrated in people who developed CRPS after injury (Birklein and Schmelz 2008, Guo et al 2004). It is postulated the elevation of these inflammatory mediators occurs as a result of inadequate inactivation after their release, so they continue to promote inflammation (Birklein and Kingery 2009). Another suggestion is that more receptors are available to receive these inflammatory mediators (Birklein and Kingery 2009). The overall effect is increased temperature, skin reddening, protein extravasation, oedema and augmented nociceptive stimulation.

The role of the sympathetic nervous system (SNS) in CRPS has remained controversial. It was originally proposed that the SNS was the main driver for CRPS symptoms, hence its previous name Reflex Sympathetic Dystrophy. Under normal circumstances sympathetic activity does not impact on the discharge of nociceptors; however in the case of CRPS, nociceptors appear to be under the influence of the SNS. This is referred to as sympathetically maintained pain (Raja et al 2010). In people with CRPS the epidermis of the skin within the region of hyperalgesia has been shown to contain a greater density of the receptors involved in sympathetically maintained pain compared to pain free skin and normal controls (Raja et al 2010). It was agreed however, that the SNS was not the sole cause of CRPS, as sympathetic nerve blocks did not provide significant relief for a number of patients (Galer et al 2001).

Based on physiological and functional imaging studies there is substantial evidence that in persistent pain states, reorganisation of the primary somatosensory cortex (the Penfield 'homunculus') (Flor 2003, Flor et al 2009), the secondary somatosensory cortex

(Pleger et al 2006), and the motor cortex can occur (Cohen et al 1991). It has been demonstrated that the degree of cortical reorganisation is directly related to the intensity of CRPS pain and the extent of hyperalgesia (Pleger et al 2005).

In the case of CRPS the cortical representation of the affected limb is smaller than that of the unaffected limb, with digit representations moving closer together (Juttonen et al 2002, Maihofner et al 2003, Pleger et al 2004). This can produce affects such as body perception disturbance, whereby people with CRPS describe their limb as feeling abnormal in terms of shape and size (Moseley 2005b), temperature (Lewis et al 2007), position (Lewis et al 2010) and orientation (Schwoebel et al 2001). It can produce feelings so intense that the limb no longer feels like the participant's own (Lewis et al 2007). It is postulated that this reorganisation can alter cortical processing, instating a conflict between sensory feedback and motor output. It has been shown that inducing a sensorimotor incongruence in normal participants can provoke sensations of spontaneous pain and feelings of peculiarity (McCabe et al 2005) and exacerbate pain in people with fibromyalgia (McCabe et al 2007). It is therefore credible that cortical reorganisation contributes to the pain experienced within CRPS. Cortical reorganisation can also produce motor dysfunction, leading to abnormal movement patterns during reaching and grasping tasks (Maihofner et al 2007).

In summary, these various mechanisms contribute to the multitude of symptoms that can develop in a person with CRPS.

Physiotherapy Management

Over the years many different treatment modalities have been utilised for the management of CRPS, including medical management (analgesics, steroids, supplements) and interventional treatments (sympathetic nerve blocks, sympathectomy, amputation and spinal cord stimulator insertion). It is well recognised however, that physiotherapy plays an important role in the standard treatment of CRPS.

Physiotherapy encompasses a large array of different treatment techniques and modalities. In order to gain a clearer insight into the efficacy of the varied physiotherapy interventions for the treatment of adult CRPS-1 a systematic review of the literature was performed (Daly and Bialocerkowski 2009). An electronic search was conducted for the period 1987-2007 using various databases and searches of textbooks on pain. Each study was appraised by the Australian National Health and Medicine Research Council (NHMRC) hierarchy of evidence and the Critical Review form for Qualitative Studies: 180 articles were found, of which 166 were excluded as they did not meet the inclusion criteria. There were 11 articles included in the systematic review. After analysing and comparing the data regarding the effectiveness of the different treatments, the authors concluded that Graded Motor Imagery (GMI) produced the greatest benefit in terms of reducing pain when compared to conventional physiotherapy and medical management. There was reasonable evidence for modalities such as mirror therapy, desensitisation training, and graded exposure; however, there was no evidence to support the effectiveness of transcutaneous nerve stimulation or stress loading exercise. The study highlighted a distinct lack of high quality research on physiotherapy management of CRPS.

This review aims to expand this systematic review by exploring the latest scientific and clinical based research developments pertaining to these techniques and discuss how they may be applied in a therapeutic setting. In addition, it explores the current research utilising recent modalities such as prism glasses and virtual reality for managing CRPS.

Mirror Therapy

Mirror therapy aims to create an illusion of normality in the affected limb. It was introduced by Ramachandran in 1992, for use with phantom limb pain and has since been adapted to aid in the management of numerous conditions, including stroke and pain after wrist fracture and hand surgery (Ramachandran and Alschuler 2009). When used for CRPS, mirror therapy involves concealing the affected limb behind the mirror, while the non-affected limb is positioned so that its reflection is superimposed to where the affected limb should be. The brain has been shown to prioritise visual input over proprioceptive input (Rock and Victor 1964), so when the unaffected limb moves it appears as though the affected limb is functioning normally.

The mechanisms of action for mirror therapy are still not fully understood. There are a number of theories described in the literature including increased attention to the limb, improved ownership of the limb (McCabe 2011), activation of the mirror neurone system (Matthys et al 2009, Rothgangel et al 2011), and a reduction of sensorimotor incongruence (Ramachandran et al 1995).

Mirror therapy has been shown to have positive and negative effects on the symptoms of CRPS (McCabe 2011). It is postulated that the discrepancies in results are due to differing methods of execution. According to McCabe (2011) mirror therapy should be performed with both limbs moving in a bilateral synchronous manner, so the person can feel the movement at the same time as observing the reflection of the normal limb moving. If movement of the affected limb is not performed in synchrony with the observed reflection, conflicting sensory feedback and motor output will be exaggerated and CRPS pain can be increased (McCabe 2011). Acerra and Moseley (2004) demonstrated that pain could be evoked in the affected limb of CRPS participants when the unaffected limb was stimulated in front of a mirror (via light touch, sharp touch and the application of cold). Interestingly, only participants with CRPS experienced pain, it did not occur in participants with similar pain symptoms (but no signs of CRPS-1) or control participants.

Mirror therapy also appears to have differing effects in the acute and chronic phases of CRPS. McCabe et al (2003) performed a pilot study which involved eight participants with CRPS-1 practicing mirror therapy for six weeks. It was demonstrated that visual feedback from the mirror significantly lowered pain intensity in acute CRPS-1 (less than eight weeks). These analgesic effects were prolonged with increasing duration of mirror therapy. In the intermediate stages of the disease (less than one year) mirror therapy reduced stiffness. Unfortunately, there was no beneficial outcome for the three chronic cases. These findings concur with other studies. In acute CRPS, Cacchio et al (2009) demonstrated an improvement to CRPS symptoms, whereas for chronic CRPS Tichelaar et al (2007) reported a poor response to mirror therapy.

When CRPS symptoms persist, patients can experience more physical impairments with changes in muscle strength, contractures, joint stiffness, or motor control. This can place more restrictions on the movement of the affected limb and further increase the incongruence between the affected limb and the mirror image. In these instances it is proposed that mirror therapy may overwhelm the sensitised system therefore exacerbating pain to a greater extent (Moseley 2005a). It has been suggested that a graded approach to cortical activation utilising techniques to activate cortical regions affiliated with movement preparation but not movement execution may be more suitable, as suggested to occur in Graded Motor Imagery (described in more detail in the following section) (Moseley 2005a). This theory was supported when it was demonstrated that during GMI, mirror therapy only imparted an effect when it followed imagery (Moseley 2005a).

In summary, the research indicates that mirror therapy can assist with pain reduction and improve function in the early stages of CRPS. Considering that it is an inexpensive and accessible form of treatment that can be performed within the clinic and continued at the patient's home, there is a basis for its use in early rehabilitation. In regards to chronic CRPS, there is limited efficacy when used as a first line treatment and in some instance it can exacerbate CRPS symptoms. Caution should be made to ensure patients are instructed on the appropriate technique, to minimise potential side-effects.

Graded Motor Imagery

GMI follows a progressive three-stage motor imagery programme. In stage 1, participants see a series of photographic flash cards, and are asked to identify (as quickly as possible) whether the depiction is of a left or right limb. In stage 2, participants imagine moving the affected limb into the position demonstrated on the photograph, while the affected hand rests comfortably. Stage 3 involves mirror therapy, whereby both limbs are moved to adopt simple postures as demonstrated on the photograph (Mosley 2004).

GMI is considered to exert its effects through sequential activation of distinct (ordered) stages of brain function (Moseley 2005a). Parsons and Fox (1998) used positron-emitting tomography to image brain activation (through blood-flow measures) during right / left judgement tasks (stage 1). A large amount of activity was shown in the pre-motor and supplementary motor regions and the cerebellum, however there was no activity in the primary somatosensory and motor cortices. Imagery (stage 2) has been shown to activate the pre-motor, primary somatosensory and motor cortices (Lotze et al 1999). This indicates that stage 1 activates brain centres involved in higher order aspects of motor control and movement preparation without physical movement of the limb, prior to progressing to stage 2 where activation of the motor cortices occur (Moseley 2005a). This theory was supported during a clinical trial in which 20 participants with chronic CRPS-1 of one hand were randomly allocated to undertake the three components of the GMI programme in different orders (Moseley 2005a). It was demonstrated that participants who followed the sequenced GMI stages (stages 1, 2 then 3) had better outcomes with reduced pain rating and increased functional task ability (measured using the task-specific numeric rating scale) than participants who did not follow the sequence. It also showed that imagined movements were only successful in producing measurable improvement when they followed hand laterality recognition; and mirror movements were only useful when they followed imagined movements.

Early support for effective utilisation of GMI was demonstrated in a randomised controlled trial involving 13 participants with chronic CRPS-1 following non-complicated wrist fractures (Mosley 2004). Participants were randomly allocated into either a GMI group following the three stage programme or a control group who did not receive treatment. Each stage involved intensive repetition, with exercises practised three times an hour, every waking hour, for two weeks before being progressed to the next stage. On completion of the GMI programme there was a significant reduction in the neuropathic pain scale (by approximately 20 points, on a 100 point scale), an improvement in swelling and reduced limb laterality recognition time. These improvements were maintained for at least six weeks after completion of treatment. The outcome measures for the control group did not change. However, when two of the control participants crossed over to GMI, there was a significant reduction in all three variables.

This study was repeated with a larger sample size including people with phantom limb pain after amputation, brachial plexus avulsion injuries and a more heterogeneous group of CRPS-1 patients. The results showed that pain decreased and function increased for the GMI group relative to the control group; however pain reduction was about 50% less in this study than the previous one (Moseley 2006).

Based on the success of these studies, GMI has been adopted by clinics worldwide. Reports are now being published to discuss the clinical implications of this technique. Johnson et al (2012) performed an audit to assess the outcomes of GMI used within two CRPS speciality centres in the UK. For practical reasons the GMI protocol deviated from that used in the studies by Moseley, with reduced face to face contact, increased duration of the stages, and reduced frequency of practice. Although this makes comparison debateable, it provides a more realistic view of the efficacy of GMI when applied in real-life clinical situations. Unfortunately, the outcomes from this study would suggest that the clinical application of GMI may not be as promising as anticipated. When assessing pain intensity, the participants reported the 'worst' pain intensity reduced but the 'average' pain intensity remained the same following treatment. On the whole, only 3 out of the 32 patients who started GMI achieved a 50% pain reduction and in 12 out of the 32 patients, pain actually increased with treatment. Lagueux et al (2012) also utilised a modified version of GMI in a clinical trial based on 7 patients with CRPS present for less than 6 months. The results indicated a reduction in pain but no statistically or clinically significant difference to function.

It seems plausible that GMI may provide an avenue to start rehabilitation at a manageable level for a patient who complains that pain is too severe to perform any kind of limb movement. By regressing rehabilitation to a point whereby only the cortical regions involved in movement preparation are activated, pain may be provoked to a lesser extent. This could then be progressed in a steady manner to promote greater cortical activation, prior to commencing functional activation. However, as Johnson et al (2012) identified, there are some cases where pain can be intensified during its use. Further

research to identify potential subgroup populations where GMI may be unsuitable, as well as clearer recommendations for the application of GMI e.g. frequency of practice, duration of stages will assist to optimise the use of GMI in clinical practice.

Tactile Discrimination

Tactile discrimination is slower in a CRPS-affected limb than in an unaffected limb (Moseley et al 2009) and in some cases, mislocalisation of sensory stimulation is present in the affected limb. Maihöfner et al (2006) demonstrated that when touching the digits of an affected CRPS hand, the sensation was felt to be in another place within the same hand in 8 out of 24 participants tested. It was also noted that the presence of mechanical hyperalgesia was a significant predictor for the incidence of sensory mislocalisation. These occurrences are considered to be related to cortical reorganisation. Flor et al (2001) demonstrated that the extent of reorganisation correlates with the magnitude of pain, and the degree of tactile acuity of the affected region. It has been suggested that tactile information processing is 'spatially' related (where the body is in space) rather than somatotopically defined (the body position in accordance to its location within the homunculus). Moseley et al (2009) studied ten participants with CRPS in a single arm. Participants received pairs of vibro-tactile stimuli, one delivered to each hand, at various asynchronies. They were asked to identify which hand had been stimulated first by releasing a foot switch to indicate left or right. This was performed with the arms held each side of the midline and then with the arms crossed over midline. The point at which participants were equally likely to select either hand was compared between conditions and between those with left and right-sided symptoms. The results showed that when arms were not crossed, the participants prioritised stimuli from the unaffected limb over those from the affected limb. In other words, it took participants longer to recognise and/or respond to the stimulus applied to the affected arm. When the arms were crossed the effect was reversed, requiring earlier delivery of the stimulus to the unaffected limb in order for it to be recognised as simultaneous to the affected limb. The study also discovered a strong correlation between the time to recognise stimulus to the affected arm and skin temperature. The earlier the affected limb needed to be stimulated in order for the two stimuli to be perceived as simultaneous, the cooler the affected limb was in relation to the unaffected limb. When the arms were crossed the temperature of the affected limb increased. It was postulated that this warming effect may indicate improved ownership of the limb. These results indicate that CRPS is associated with a deficit in tactile processing that is defined by the space in which the affected limb normally resides, not by the limb itself.

In order to normalise tactile acuity, techniques such as sensory discrimination training have been employed. Sensory discrimination training has been shown to be effective in improving pain and two-point discrimination for people with phantom limb pain. These changes were accompanied by normalisation of the somatosensory cortical organisation (Flor et al 2001). Similar results have been shown for people with CRPS (Pleger et al 2005) however it appears that the technique for delivering sensory training is paramount. Approaches which involve active participation from the participant, such as distinguishing the location and type of stimuli applied to the affected area, have been shown to be more effective at reducing pain and improving tactile acuity than passive stimulation (touching the affected region with no conscious thought to the stimuli) (Moseley et al 2008a).

In summary, tactile discrimination training techniques which encourage patients to concentrate on the delivered stimuli can improve tactile acuity and reduce pain. Following such training, functional imaging studies have demonstrated improvements in cortical re-organisation (Pleger et al 2005).

Exposure Therapy

It is well documented that pain-related anxiety and fear are strong predictors of pain disability in people with various chronic musculoskeletal conditions (De Jong et al 2011). This can lead to a vicious cycle of pain, fear, and disability. In some cases people living with pain can develop activity avoidance or hypervigilance. In the acute phase of tissue injury these behaviours may be useful for healing but as pain persists they become detrimental. For people with CRPS these behaviours may lead to fear avoidance of using their limb, guarding and protecting it, and developing maladaptive coping strategies. This can lead to secondary changes associated with non-use, which can result in a further decline in function. De Jong et al (2011) explored the concept of fear avoidance of movement in terms of functional limitation in people with CRPS-1. In people with acute CRPS the severity of pain determined functional limitation, not fear. Conversely, in people with chronic CRPS perceived harmfulness of activity correlated stronger with functional limitation than the impact of pain intensity. Moseley et al (2008b) demonstrated that fear of movement and catastrophic thoughts can have a negative impact on swelling and pain in the affected limb when performing imagined movements. It is therefore important that fear-avoidance is addressed early.

One approach to tackle fear-avoidance is to perform graded exposure to the feared stimulus. Graded exposure therapy follows a structured process involving screening, education, and graded exposure (Vlaeyen and Linton 2000). Overall, the process aims to stimulate fear, then disconfirm the fear by providing new information on the feared activity, whereby inaccurate predictions about activities causing harm, are dispelled (Philips 1987).

Graded exposure has been explored in a number of pain conditions including chronic low back pain (Macedo et al 2010); post-traumatic neck pain (De Jong et al 2008, Wicksell et al 2008); and generic pain conditions (Bliokas et al 2007, George et al 2010) with mixed results. In regard to CRPS, a small study based on eight female participants with chronic CRPS, demonstrated that graded exposure was successful in decreasing levels of pain-related fear, pain disability, and pain intensity. Participants also reported reduced signs and symptoms of CRPS-1 (such as swelling or colour changes). At a six month follow-up, the eight participants had complete resolution of their symptoms (De Jong et al 2005).

Anecdotal evidence indicates that encouraging participants to face feared activities may however provoke pain and exacerbate CRPS symptoms. Ek et al (2009) therefore assessed the safety of exposure therapy by encouraging patients to focus on functional improvement while neglecting the pain. The outcomes were positive, from 102 people who completed the functional

exposure programme, 49 achieved full recovery in terms of function, 46 partial recovery, and five experienced no change. The authors also found that pain scores reduced in 76 patients, increased in 14, and did not change in 12. From those patients whose pain worsened or did not change, 10 had achieved full function. Interestingly, only four participants dropped out as they considered the interventions too strenuous and painful. The study concluded that treatment focussing on functional restoration can be applied safely and effectively for patients with chronic CRPS. This work was expanded to include assessment of specific CRPS symptoms, including oedema, skin temperature, skin colour, joint mobility, muscle strength, and pain during exposure therapy (Van de Meent et al 2011). These authors used a progressive-loading exercise programme, desensitising techniques, forced use of the affected limb in daily activities and management of pain-avoidance behaviour, without the use of specific CRPS-1 medication or analgesics. Participants were discouraged from complaining about the pain and treatment intensity was not reduced because of pain. On monitoring the symptoms of CRPS-1, two out of the 20 participants had a slight increase in oedema during treatment, whereas temperature differences and colour changes between limbs improved in some participants during treatment. Pain increased in five cases during treatment but on the whole declined following treatment. Joint mobility and arm strength increased; and following treatment, measures determining 'functional use', 'fear avoidance to activity', and 'quality of life' all showed improvement. There were no participants who withdrew from the study due to discomfort or adverse effects.

Due to the risk of initially increasing pain intensity, the studies exploring exposure therapy highlighted the importance of ensuring the patient was adequately educated and motivated to be compliant with treatment regimes, in order for it to be successfully tolerated. These studies provide reassuring evidence that treatments focussing on activity whilst ignoring pain can be safely applied with no deterioration of CRPS-1 symptoms.

Virtual Reality

With the ever growing developments in technology, the theories regarding mirror therapy have been expanded into the virtual world, with studies looking into the efficacy of virtual reality systems for managing pain. There is currently evidence to demonstrate efficacy of virtual reality for acute pain (such as during routine medical procedures) (Gold et al 2005), burns (Hoffman et al 2000), cancer pain (Sander et al 2002, Schneider and Workman 2000), and more recently, CRPS. Sato et al (2010) developed a computer-based programme linked to a glove which was embedded with sensors to detect movement of the hand. The glove is worn on the unaffected hand but produces an image on the screen of the opposite (affected) hand. Participants are instructed to focus on the motion of the virtual hand while performing motor tasks such as reaching out, grasping, transferring, and placing. The programme was tested on five participants with chronic CRPS-1 who were seen weekly for this treatment for up to eight sessions. They found that four out of the five patients showed a 50% reduction in the pre-treatment pain score. In two patients, the analgesic effect continued after cessation of the therapy and no participants described any treatment related side-effects.

Virtual reality has been shown to produce analgesic effects through modulation of sensory and emotional aspects of pain processing with reduced activity demonstrated via fMRI in areas such as caudal anterior cingulate cortex which is involved in the emotional aspects of pain; the somatosensory areas, involved in registering location and intensity of pain; as well as the thalamus and insula (Hoffman et al 2004).

Unfortunately its widespread use is limited as the equipment is expensive and can only be used within the therapy clinic. With ongoing developments of next generation home gaming systems, it will be interesting to see if similar results may be achieved with accessible and cheaper alternatives. The added advantage of virtual reality and 'gaming' treatments are that they are based on activities which patients are more likely to find fun and/or interesting to do. This may improve compliance and activate the brains reward systems, leading to the release of dopamine which strengthens and consolidates learning and neurological plasticity (Harley 2004, Wise 2004).

Minimising Body Perception Disturbance

People with CRPS-1 have been described in numerous texts to exhibit 'neglect-like' behaviours similar to that which may follow neurological insult such as stroke (Galer et al 1995, Galer and Jensen 1999). Following work by Förderreuther et al (2004) and Lewis et al (2007), the term 'neglect' for CRPS has been superseded by the term 'body perception disturbance'. In order to move the affected limb, people with CRPS-1 frequently comment on their need to consciously focus their mental and visual attention to the limb, often describing the limb as "not belonging to me" (Galer and Jensen 1999, Moseley 2005b, Lewis et al 2007).

Body perception disturbance not only involves changes in the perception of the body part itself but in how that body part relates to the body and the space in which it occupies. As discussed in the section regarding tactile discrimination, Moseley et al (2009) demonstrated that crossing the affected limb over to the other side of the body influenced sensory acuity and skin temperature. Sumitani et al (2007a) demonstrated that people with CRPS showed a shift in subjective body-midline with a bias towards the affected side which is contrary to previous thoughts of CRPS neglecting the space of the affected side.

In order to normalise body perception disturbance, treatments aimed at correcting cortical remapping are considered appropriate (Lewis et al 2007). It is postulated that delivering normal stimuli to the affected limb and encouraging the patient to engage with the limb may assist to normalise sensory and motor responses. This can include utilising the techniques described in the preceding sections, which are considered to influence cortical activation and organisation (Pleger et al 2005, Maihofner 2007). A number of other gadgets and appliances have also been trialled with the intention of tricking the brain to improve body perception, such as prism glasses and minifying lenses.

Prism glasses are based on the principles of mirror therapy, but were designed to allow portable treatments which can be performed more regularly. They utilise a wedge prism to add visual displacement towards the affected side while the vision in the other eye is blocked. When the patient moves the non-affected limb the prism inverts the image to appear as

though the affected limb is moving. Prism glasses have been used with success for managing hemianopia (blindness in half of the visual field in both eyes—either the left or the right field) (Bowers et al 2008, Giorgi et al 2009) and for patients with stroke and hemispatial neglect (Fujiwara et al 2011, Keane et al 2006). In terms of their use for CRPS, Sumitani et al (2007b) demonstrated that performing visual subjective body-midline judgment tasks while wearing the prism glasses with a 20° prismatic displacement of visual field toward the unaffected side for two weeks alleviated pain in five patients with CRPS. There was also an improvement in proprioception and limb position awareness. When the prism glasses were displaced 20° toward the affected side, pain increased.

Bultitude and Rafal (2010) provided a single case report of a patient with early CRPS managed with prism glasses and mirrors. Following activities involving the prism glasses, the patient noted a decrease in pain, swelling and temperature, and improvements to range of motion of the limb. After nine days of treatment, the patient was pain free.

Minifying lenses are inverted binoculars which make objects appear smaller. Their potential use was demonstrated in a study by Moseley et al (2008c) whereby 10 participants with unilateral arm pain performed various hand movements. Participants observed their arm moving under four conditions; with no visual appliance; through binoculars with no magnification; through magnified binoculars; and looking through inverted binoculars. Although movement aggravated pain in all conditions, it was intensified to a greater extent when the arm was magnified. Interestingly, the increase in pain intensity and swelling was least when the image of the arm was minified. This study adds further weight to the evidence for the link between vision and proprioception, and how central processes can be manipulated through visual input. It is possible minifying lenses create the illusion that fewer sensory neurones have been activated, distorting the afferent input and reducing cortical activation. Research to investigate this theory is still required.

CONCLUSION

Although the pathophysiological mechanisms for CRPS are still not fully understood, there is increasing evidence for the role of the central nervous system in the development and/or maintenance of CRPS. Changes to cortical processing and organisation can lead to the development of symptoms such as body perception disturbance, sensory incongruities, and motor dysfunction. Over recent years there have been advances connecting neuroscience to clinical practice, with physiotherapeutic techniques focussing on central modulation growing in popularity. There is emerging evidence for techniques including mirror therapy, tactile discrimination training, GMI, graded exposure therapy, and virtual reality. Physiotherapists are at the forefront of initiating these techniques with CRPS patients. An understanding of the mechanisms of action and clinical effectiveness will help physiotherapists use these techniques in clinical practice.

KEY POINTS

- Expanding research in the field of neuroscience is improving our understanding of CRPS.
- With advanced understanding of CRPS-related brain and spinal cord processes, treatment modalities are moving away from peripheral management to focus on central processing.
- Techniques such as mirror therapy, Graded Motor Imagery, tactile discrimination training, and graded exposure therapy show promise in the management of CRPS.
- Physiotherapists are at the forefront of initiating these techniques with CRPS patients.

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People seeking treatment for a new episode of neck pain typically have rapid improvement in symptoms: an observational study

Leaver AM, Maher CG, McAuley JH, Jull G, Latimer J, Refshauge KM (2013) People seeking treatment for a new episode of neck pain typically have rapid improvement in symptoms: an observational study. Journal of Physiotherapy 59: 31-37. (Abstract prepared by Scott Farrell)

Objective

To investigate the clinical course of a new case of non-specific neck pain, when treated by a primary care manual therapy practitioner.

Methods

An observational study was undertaken involving 181 participants aged 18-70 years (mean 38.8 years) with a new case of non-specific neck pain, who sought treatment from a physiotherapist or chiropractor at one of 11 clinics in Sydney, Australia. Recruitment was undertaken in the context of a concurrent randomised trial comparing the effectiveness of two manual therapy techniques in the treatment of acute neck pain (Leaver et al 2010). Participants were excluded from the sample if their neck pain was related to trauma (e.g. motor vehicle accident); distal symptoms were the primary complaint; they had a history of neck surgery; neck pain severity was rated less than 2 on a 0-10 visual analogue scale (VAS); or they demonstrated signs of sinister or specific pathology (e.g. fracture, malignancy).

Participants received four treatment sessions over two weeks from an experienced physiotherapist or chiropractor, comprising manipulation or mobilisation (depending on trial group allocation), as well as exercise prescription, electrophysical agents and/or activity modification advice, at the discretion of the treating clinician. Participants completed baseline questionnaires detailing demographic and clinical variables at their initial appointment, and over a three-month period, used standardised diaries to record severity of pain (0-10 VAS) and activity limitation. Telephone interviews were conducted throughout the three-month period, including an exit interview. Pain and activity recovery times, pain and disability at three months, and clinical and demographic prognostic factors were the primary outcome measures.

Results

Mean pain scores improved from a baseline of 6.1 (SD 2.0) to 2.5 (SD 2.0) at two weeks, to 1.5 (SD 1.8) at three months, with 53% of participants indicating their neck pain had completely recovered by the end of the study. Mean disability (quantified on a 0 to 50 scale) decreased from 15.5 (SD 7.4) initially to 5.4 (SD 6.4) at three months. Factors associated with faster recovery were better self-rated general health, shorter duration of symptoms, being a smoker, and no concurrent head or upper back pain. Factors associated with higher disability at three months were older age, higher baseline disability, concurrent back pain, and previous sick leave for neck pain.

Conclusion

Patients suffering a new case of non-specific neck pain that undergo physiotherapy/chiropractic manual therapy treatment generally demonstrate a rapid decrease in pain severity. Lingering pain and disability are relatively uncommon, and a number of prognostic indicators can identify those patients at risk of ongoing disability. This information can serve to guide clinicians and to reassure patients in a primary care setting.

Commentary

This observational study provides information useful to clinical practice, as neck pain is a problem commonly managed by physiotherapists, estimated to affect 30-50% of the adult population over a 12-month period (Hogg-Johnson et al 2008). The results suggest that patients suffering a new case of non-specific neck pain being managed in a primary care physiotherapy or chiropractic setting typically experience a rapid and significant reduction in pain and associated disability. Despite a moderate degree of reported pain and disability initially, the patients in this study demonstrated a rapid decrease in pain and return to normal activity usually within two weeks of commencing treatment. More than half (53%) of the participants reported a full recovery from their neck pain, 75% of which occurred within four weeks. This is important, as it provides a grounding from which clinicians may educate and reassure patients presenting with a new case of neck pain regarding their recovery, as per ACC guidelines (ACC 2009).

These results also provide clinicians with prognostic indicators for those patients likely to exhibit a rapid recovery, as well as those at risk of ongoing neck pain-related disability after three months. Identification of such patients could assist in clinical decision-making, for example prompting the early referral of patients likely to suffer ongoing disability to other members of the multidisciplinary healthcare team.

There are a number of issues to be considered when applying the results of this study to a wider healthcare context. First, as the study is observational, not a randomised control trial, it cannot be said if the observed recovery time is due to the treatment received or a result of natural healing processes. Second, a number of the demographic variables suggest the sample is not representative of the wider Australian population. For example, in this study 9% of participants were smokers, and 60% held a university degree or higher. However, the Australian Bureau of Statistics (2012a, 2012b) report that in 2012, 16.3% of Australians were smokers and 25% held a bachelor's degree. Furthermore, considering that private physiotherapy and chiropractic clinics in Australia are not publically funded, it could be inferred that the sample has a positive socioeconomic bias. Finally, as the study was undertaken within the framework of a manual therapy trial a selection bias should be considered, as the authors report that in the manual therapy trial, participants were excluded if the treating clinician did not feel manipulative therapy was indicated. This may well limit the applicability of the prognostic findings of this study to a wider clinical context.

This study provides clinicians with insight into the clinical course of acute neck pain when managed in a primary care manual therapy setting, including identification of prognostic indicators of rapid recovery and ongoing disability.

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Cardiorespiratory Assessment of the Adult Patient: A clinician's guide. (Physiotherapist's Tool Box) [Spiral-bound]

Mary Ann Broad, Matthew Quint, Sandy Thomas, Paul Twose (Eds) 2012, Churchill Livingstone Elsevier, Edinburgh ISBN 9780702043451 RRP: Approx NZ$60

This new textbook aims to give students and physiotherapists new to cardiorespiratory practice a simple and easy to use introduction to the assessment of patients with cardiorespiratory disorders. The first two chapters are short introductions to the scope of respiratory physiotherapy in different settings (Chapter 1) and assessment checklists that physiotherapists may use for the main clinical settings in which they will treat patients with cardiorespiratory problems (Chapter 2). Chapter 3 forms the main portion of the text and focuses on assessment tools/techniques that are presented alphabetically for ease of navigation. The book aims to give a simple, step-by-step explanation of exactly how each assessment technique should be performed and how to interpret the results of these. Each technique has a *definition* of the assessment procedure, an explanation of the *purpose* of the procedure, how to *perform* the procedure, consideration of the *findings* and how to *document* the results of each of the assessment findings. Chapter 4 attempts to integrate the assessment findings through three case scenarios across different settings and develop some basic problem solving and clinical reasoning skills.

Overall, the text is very easy to read and mostly easy to navigate through. Occasionally the alphabetical listing of the assessment tools is not entirely intuitive and some tools appear in more than one section e.g. central venous pressure is discussed under cardiac monitoring and under its own dedicated section; cross-referencing occurs to assist with the navigation of this. Additionally, some sections lack the specifics to actually perform a full test e.g. exercise testing but, usefully, include references for further reading. Also useful for students will be the scattering of 'Hot Tips' boxes throughout the text.

Some aspects of this first edition text would benefit from further editorial tweaking. For example, several charting sections are included in the text such as ICU, muscle grading and TPR charts. Many assessment tools included in these charts (e.g. pulse and respiratory status) have been discussed separately within the text. Thus, the inclusion of charts within the text appeared slightly incongruous compared with the more 'practical' aspects of the text. It is, however, useful to see the inclusion of assessment of neuromuscular aspects of assessment of patients with cardiorespiratory problems, such as reflex, dermatome and myotome assessment.

Aesthetically, I would also have liked each new assessment tool to commence on a new page with, perhaps, some space for readers/users to jot their own notes. This would also help with the quick navigation around the text that might be useful in the clinical situation. In addition, the summary page on normative values is a token gesture and could be much more extensive.

Given all of the above, the book is a very useful addition to the cardiorespiratory physiotherapy genre and will make a good addition to the student/ junior physiotherapist's library, especially given its relatively low cost. I would recommend that all departments have a copy of this text that can be relatively easily accessed to help guide junior therapists through assessment of the patient with cardiorespiratory problems.

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Communicating in the health sciences

Joy Higgs, Rola Ajjawi, Lindy McAllister, Franziska Trede, and Stephen Loftus, Oxford University Press, 2012, Third Edition, ISBN 978-0-1955-7904-8, 368 pages. RRP: $70 (Fishpond <http://www.fishpond.co.nz>)

The great Greek philosopher Epictetus once said, "We have two ears and one mouth so that we can listen twice as much as we speak." Skilled communication involves developing both listening and speaking skills but this publication presents communication as much more than just these simple acts.

Following the second edition, published in 2008, this third edition as in former editions uses a 'person-centred' practice approach but has gone through a major restructure and layout, allowing for better flow, and reader learning. This book is easy to read by striking a balance through the use of plain English with that of professional language.

Each chapter starts with a list of key topics and terms, with good use of margin definitions and in many parts the text has been enriched with more extensive content. As in former editions, this book continues the use of 'handy hints', flow-charts, tables and figures, though sadly none in colour which would have given it a more aesthetic appeal to the reader. Finally this third edition has added a new chapter titled 'Digital Communication in a Networked World' to keep pace with the rapid advancement and ever increasing use of technology in the field of communication in healthcare. This chapter introduces to the reader the concept of a digital identity, use of eportfolios, social media and mobile learning. While the text does point out the advantages and disadvantages using these communication mediums, it lacks the necessity to educate the reader about the protection of health workers and patients/clients from digital identity theft and/or the release of personal sensitive and confidential information into the networked world.

This third edition book is intended equally for the student, academic and clinician. The book achieves this by using three logical sections in its layout. The first two parts of the book encompass communication skills within the academic setting. Parts three and four delve into communication skills required working in the professional/clinical work environment, when communicating with patients/clients, carers, colleagues, and other health professionals alike. The final part of the book focuses on advanced professional skills such a thesis and journal writing, and preparing poster and conference presentations.

There are many texts published on the subject of 'communication in healthcare', however, few exist where the majority of contributing authors hail from Australia; though sadly none from New Zealand. This and with its approach to communication skills should allow the New Zealand reader to identify easily with its philosophy of a person-centred model of health care.

As an academic and lecturer teaching in an undergraduate physiotherapy curriculum I would recommend this book to my colleagues and students as an good starting guide to communication in the health care setting. It will provide students with good structure while developing their skills in communication throughout their formative academic and clinical learning years. While more limited, the fifth part of this book offers important information and tips to the practitioner planning to return to academia to undertake further post-graduate study.

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Pain Co-Morbidities: Understanding and Treating the Complex Patient.

Editors: Maria Adele Giamberardino and Troels Staehelin Jensen. Published by IASP. Seattle.2012.

The editors aim was twofold, first to give clinicians a better understanding of the influence of co-morbidities on the experience of chronic pain and secondly how to provide optimal care for these patients. To this end the top researchers and clinicians in the field have all contributed chapters.

The book is divided into three sections - the first dealt with general aspects, epidemiology and models, both human and animal. This was interesting in terms of the development of pain from non-painful co-morbidities and the parallels in pain between animals and humans found in experimental studies. Genetic, hormonal, immunological and psychosocial influences on chronic pain were also discussed.

Section two looked at ten specific conditions and how these conditions affect chronic pain. Some conditions covered were hypertension, diabetes and obesity. This was valuable to the clinician as a reminder to do a thorough assessment of all body systems with each client and then treat appropriately. John D Loeser's comment that "the complaint of pain almost always decreases as the co-morbidities are successfully managed" sums up why we need to broaden our approach to these patients.

The third section looked at treatment methods, such as the MDT team, pharmacological and psychological approaches, and psychiatric attitudes to anti-depressants.

As a physiotherapist working mainly in Pain Management, I found this book very informative in some places and in others it was overly complex and repetitious. Within my own department the chapter on Pain and Hypertension was used to promote discussion at a practice tutorial and subsequently stimulated some clinicians to further their own knowledge in this area.

The strengths of the book are the calibre of the authors, the chapters on the co-morbidities and from a biased point of view the MDT chapter. The excellent list of references and the overview of all chapters presented at the end of the book were all added bonuses. One of the weaknesses was how much information overlapped between authors as this caused a high amount of repetition and affected the overall quality of the book. I think it is a useful reference book and a valuable resource to ascertain how certain conditions would affect a client's pain.

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In Our Hands 100 years of Physiotherapy at Otago 1913-2013

Louise Shaw 2013, University of Otago School of Physiotherapy, Dunedin, New Zealand. ISBN 978-0-473-23850-6. Hard covered, 146 pages. RRP: $45.00

In the fast moving world of today, there is a tendency to feel that history is irrelevant, but "The farther back you can look, the farther forward you are likely to see" (Winston Churchill). "In our hands" is an in depth history of physiotherapy at Otago and the New Zealand School of Physiotherapy by historian Louise Shaw. It holds the reader's interest from the photograph on the front cover, entitled 'The Humerus' (1952) to group photographs of students and staff at the University of Otago in 2012.

How did we progress from 'a halo of mystery' using massage, magnetism and medical electricity to 'care and alleviate' abnormal conditions of the body into fitness and preventative work 'based on regular exercise and correct breathing techniques' to the evidence based practice of today including preventive education and rehabilitation, and encompassing non-communicable diseases? Who are the many personalities who led the way in the development of the profession as it became based on science rather than belief? What were the key elements of a rigorous education which led to professional registration and legitimising of the profession? What is balneology? When and how did the word 'physiotherapy' become recognised?

Many of us have been under the impression that our education was based on that of Schools of Physiotherapy in England, but the Otago School of Physiotherapy was modelled on Australia's first formal education programme in massage therapy. This had been established in Melbourne in 1906 and included both university teaching and hospital based training. It was a more rigorous education programme than that of our British colleagues at the time. There were also influences from Sweden, Germany and later England and the United States. It was only under Miss ML Roberts that the curriculum was brought more in line with that of the Chartered Society of Massage and Medical Gymnastics of Great Britain and full reciprocity was established after the Second World War.

Our training began within the University of Otago, was moved to the auspices of the Otago Hospital Board, the Otago Polytechnic and then back to the University of Otago where it continues to grow and develop and maintain its international reputation but its passage, from 1913, has not been uneventful. Throughout its time the profession has been closely aligned to the medical profession and this has facilitated the growth and development of physiotherapy from a 12-month certificated profession allied to medicine to a four-year degree programme and an autonomous profession with higher degree opportunities. Only occasionally were there elements within the medical profession keen to limit competition.

Louise Shaw has covered a century in time and brought together a wealth of information from innumerable sources, carefully and clearly referenced. Each chapter is interspersed with generic images e.g. The first ideal quality of a masseuse, taken from the Nursing Times 5 April 1913, and published on page 35 reads: ".. and the perfect hand for massage should be soft, dry, smooth, and somewhat plump and warm, a hand which inspires confidence at its first touch..". The material is beautifully presented and an enjoyable and engaging read for physiotherapists (undergraduate and postgraduate), our medical colleagues and others with even the smallest interest in where we came from. It is a recommended addition to all medical libraries and for many personal libraries – once in the hand, it cannot be put down.

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