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Review Article

Equine physiotherapy: a comparative view of the science underlying the profession

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Introduction

This review presents a comparative viewpoint to accompany that published by Buchner and Schildboeck (2006). In their review the authors searched the veterinary literature for evidence behind selected physiotherapy modalities that have been used in the horse. However the present review focuses on the science behind physiotherapy and extends beyond the boundaries of the veterinary literature into the basic science and physiotherapy literature.

Physiotherapy is an important allied health profession in the medical field where physiotherapists contribute an essential part to the care of individuals, from the young to the aged; including an essential role in elite sports. Depending upon the country, the legally protected professional title varies and includes physiotherapist, physical therapist and chartered physiotherapist.

More recently, animal physiotherapy has emerged as a special clinical interest area of the physiotherapy profession, working closely with veterinarians in the treatment of animals. In the equestrian world, this encompasses the assessment and treatment of horse and rider. The profile of this relationship has been heightened by the official use of physiotherapists during Olympic and international level equestrian competitions for many of the teams including England, Australia and New Zealand. The equestrian sports are rapidly catching up with other international competition sports, such as football and athletics, where individuals and teams utilise the professional service of physiotherapists in the treatment, maintenance and performance enhancement of horse and rider. Despite the high profile of equine physiotherapy, it is still an emerging subdiscipline of the physiotherapy profession; and limited information is available about its definition and where it fits professionally alongside that of the veterinary profession.

Physiotherapy is a wide ranging profession with many formally recognised special interest areas. For example, there are 6 internationally recognised subgroups of the World Confederation for Physical Therapy (WCPT): namely the International: a) Federation of Orthopaedic Manipulative Therapists, b) Federation of Sports Physiotherapy, c) Organisation of Physical Therapists in Women's Health, d) Association of Physical Therapists Working with Older People, e) Acupuncture Association of Physical Therapists and f) Private Practitioners Association.

Therefore, it would be an impossible task to review the entire profession and its applicability to equine physiotherapy. The key area of physiotherapy applicable to horses is musculoskeletal physiotherapy, encompassing assessment, treatment and rehabilitation of neuromuscular and musculoskeletal disorders. Underpinning musculoskeletal physiotherapy are the sciences of functional biomechanics, neuromotor control and exercise physiology. The aim of this review is to discuss the science and evidence behind the physiotherapy profession; and the relevance or application of key aspects of musculoskeletal physiotherapy and its underpinning science to the performance horse.

Definition of physiotherapy

Physiotherapy has been defined by the Australian Physiotherapy Council (Anon 2006) as '*a holistic approach to the prevention, diagnosis and therapeutic management of pain, disorders of movement or optimisation of function to enhance the health and welfare of the community from an individual or population perspective*'. One of the fundamental differences between physiotherapy and the medical or veterinary professions is that physiotherapists are trained to focus on the assessment and management of a patient's function, rather than focusing purely on the particular patho-anatomical diagnosis. This focus includes the pathophysiological features and biomechanical abnormalities underlying the pain and movement disorders of their patients. Physiotherapists aim to restore painless optimal function and, of course, prevention of loss of function. This is not dissimilar to the veterinarians aim of restoration of equine performance due to musculoskeletal or neurological dysfunction, and highlights the synergy between the 2 professions.

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Practice of physiotherapy

Physiotherapy is a profession with over 100 years of history. It is not merely the technical application of one or more treatment modalities (e.g. heat, cold electrotherapy) as inferred in the review by Buchner and Schildboeck (2006). Physiotherapy involves using a professional assessment and reasoning process to select appropriate interventions or treatments for individual patients. The profession of physiotherapy uses an evidence-based, clinical reasoning process to underpin its management approaches. The process is the same as the veterinary medical based process, although the overall aim is different. The physiotherapist's aim is to reach a functional diagnosis that is: what are the neurophysiological and pathophysiological processes in the sensory and motor systems underlying pain and functional impairment related to the pathology/disease process? In contrast, the veterinary medical approach has been to reach a patho-anatomical diagnosis (what are the pathological processes occurring and where are they located?). Clearly, both are required and this again highlights the synergy of veterinarians and physiotherapists working together.

This difference in aims is important as it also dictates the treatment and rehabilitation options used. Physiotherapy treatments are selected to manage sensory and motor disturbances and provocative factors in work or sport for functional improvement and activity specific performance rehabilitation. Physiotherapists use physical interventions, such as manual therapies, specific motor retraining, exercise prescription and electrophysical agents, in conjunction with education and advice to restore function and quality of life. Selection of, and appropriate combination of, techniques is based on clinical reasoning (assessment and reassessment of the patient, with reassessment of improvement dictated by objective outcome measures) and evidence available.

Physiotherapy research

Just as physiotherapy practice focuses on the detection and treatment of abnormalities of function i.e. the patient with pain, movement impairments and functional disablement, so does much physiotherapy research. Research in physiotherapy has a very broad scope in the basic, behavioural and clinical sciences. Much of the basic research on musculoskeletal disorders has, in the last decade, focused on the neurosciences, including neuromotor control and pain associated with musculoskeletal conditions and the interrelationship between pain and function. This compliments work in biomechanics and kinematics. In this research, functional impairments and interventions have been studied and randomised clinical trials performed, comparing one or more approaches. Now physiotherapy research is at the level of sufficient volume, such that there are systematic reviews and practice guidelines in many areas (see Cochrane [www.cochrane.org] and Pedro [www.pedro.fhs.usyd.edu.au] databases). For example, a search on manual therapy (stretching, mobilisation, manipulation and massage) looking at the specific area of lumbar spine, sacroiliac joint and pelvis, revealed 101 systematic reviews and over 300 ranked clinical trials (Pedro database, 2006).

Clearly, equine physiotherapy research is well behind that devoted to the human subject. However, in rectifying this situation and advancing equine specific physiotherapy research, it is important to step back from the randomised controlled trial of an intervention (or more poorly controlled version of the application of a modality to an animal) and go back to fundamental science. Much of the basic scientific literature has used animal models and, while these are not horses, the quadruped model in e.g. rodents (Somers and Clemente 2006), dogs (Babbage *et al.* 2006) and pigs (Indahl *et al.* 1997), is closer to the horse than the biped. Therefore, much fundamental research exists indirectly in the sciences that underpin the profession of physiotherapy. Equine research in biomechanics is evolving. Research in normal locomotion has included biomechanics of the hoof (Eliashar *et al.* 2002; van Heel *et al.* 2006), back (Haussler *et al.* 2001; Faber *et al.* 2001) and limbs (Clayton *et al.* 2000; Hodson *et al.* 2000; Clayton *et al.* 2001; Hodson *et al.* 2001). Equine research also encompasses muscle recruitment during locomotion using electromyography (Robert *et al.* 2002; Hoyt *et al.* 2005; Wickler *et al.* 2005). Further, research into the biomechanical effects of lameness (Weishaupt *et al.* 2004, 2006a), of riders and saddle pressures (Fruehwirth *et al.* 2004; Peham *et al.* 2004; de Cocq *et al.* 2006) and head and neck position (Weishaupt *et al.* 2006b) have advanced the biomechanical research from the normal horse, to an understanding of some of the changes and compensations associated with various alterations to normal locomotion during performance or dysfunction. This functional biomechanics is essential for forming a solid science behind future physiotherapy research and practice in the future. With respect to pain, less equine specific research has been reported, but objective measurements of pain in horses (Haussler and Erb 2006; Varcoe-Cocks *et al.* 2006) have been reported.

One of the major and current areas of interest in human musculoskeletal physiotherapy is the field of neuromotor control and dynamic stability. Research in this area has allowed major advancements in the prevention and treatment of major problems in human subjects including pelvic (Richardson *et al.* 2002) and back pain (Hodges 2003), as well as prevention and treatment of peripheral joint injuries (Reinman and Lephart 2002a,b) and performance enhancement in athletes (Saunders *et al.* 2005). These problems are key issues in equine performance and wastage (Jeffcott *et al.* 1982), and research in these areas for horses is clearly warranted.

Neuromotor control in human back and pelvic pain

The challenge of prevention and management of back and pelvic pain in man has underpinned a tide of research into the trunk and back muscles. Both how the muscles work to provide support and protection to the lumbo-pelvic region in functional postures and movements, and the reactions in the system to pain and injury are being investigated.

Spinal stability and control of movement is highly dependent on the contribution of the muscular system. In the past, attention focused on muscle strength. However, it is now realised that the central nervous system's control of the muscle system (i.e. when and how the muscles work) is probably of greater importance to the muscle system's ability to satisfy the needs of spinal movement and stability (see Hodges 2004 for review). The central nervous system must plan suitable strategies of muscle recruitment, coordination and levels of activity to meet the demands of internal and external forces and initiate appropriate responses to unexpected disturbances of movement and function.

All of the many muscles of the back and trunk contribute to movement production and spinal control and support.

Nevertheless, research has shown that the deep, local muscles of the region (for example, the *transversus abdominis* and the segmental *lumbar multifidii*) have key roles in modulating stiffness of the lumbar spinal segments and pelvic joints during limb and lumbo-pelvic movements (Indahl *et al*. 1997; Richardson *et al*. 2002; Hodges *et al*. 2005). It has also been shown that the central nervous system preprogrammes activity in certain trunk muscles in preparation for limb movement, but activity in the *transversus abdominis* always occurs prior to limb movement, regardless of direction, purportedly to use the attendant rise in intra-abdominal pressure and tensioning on the thoracolumbar fascia to increase segmental stiffness for spinal segmental support prior to loading (Hodges and Richardson 1997, 1999). Ironically, several key studies have shown that, in the presence of low back pain, the strategies used by the central nervous system to control trunk muscles may be altered and less efficient muscle recruitment strategies result (Hodges 2001). Back pain patients, for example, display delayed activation of the *transversus abdominis*, depriving the painful and injured spinal segments of timely support.

There is also both *in vivo* and *in vitro* evidence of the ability of the *multifidus* muscle to control intervertebral motion. Yet morphological changes have been shown in the *multifidus* muscle in association with low back pain and the beginning of these changes (reduced cross-sectional area of *multifidus*, suggestive of inhibition) is present within 24 h of injury (Hides *et al*. 1996). What is notable is that there is not an automatic reversal of these changes following the resolution of pain. Despite apparent recovery or resolution of pain, following an episode of acute back pain, the dysfunction of *multifidus* persists (Hides *et al*. 1996).

Knowledge gained from this research, related to the changes in neuromotor control that occur with back pain, have translated to the development of new rehabilitation strategies for the lumbo-pelvic muscles in back pain patients. MacDonald *et al*. (2006) have reviewed the application of this evidence into clinical practice. Rehabilitation places emphasis on motor relearning to optimise motor control for spinal dynamic stability. Rehabilitation first uses the end organs of the neuromotor system - muscles - with the aim that cognitive, repeated contractions of the muscles and correct movement patterns result in a transition to automated use (i.e. skill training: O'Sullivan *et al*. 1998). Initially, the deep muscles, such as *transversus abdominis* and lumbar *multifidus*, are repeatedly activated in the relearning process during rehabilitation. Movement patterns and strategies for all trunk muscles are then re-educated to retrain painless and controlled functional activities. The stability system is functionally challenged with load (static and dynamic exercises) as control is improved. Most importantly, there is growing evidence that this exercise approach can reduce low back pain and possibly reduce its recurrence rate (O'Sullivan *et al*. 1997). Specific physiotherapeutic intervention in individuals with *multifidus* dysfunction, following an episode of acute back pain, reduced the rate of recurrence of injury to 30% in the physiotherapy intervention group compared with 84% for controls (Hides *et al*. 2001).

Neuromotor control in equine back and pelvic pain

Research in equine physiotherapy using both functional biomechanics and the human physiotherapy model has recently been used to investigate various equine problems including sacroiliac joint (SIJ) biomechanics (Degueurce *et al*. 2004; Goff *et al*. 2006) and equine back pain (Denoix 1999; Stubbs *et al*. 2006).

Stubbs *et al*. (2006) applied the human model of researching the equine *multifidus* muscle to the horse and found striking similarities in structure and function. The *multifidus* in the horse was shown to be similarly morphologically oriented and therefore function comparable to that in man, with the *sacrocaudalis dorsalis lateralis* muscle continuing the functions of the *multifidus* in the caudal spine. This is an example of how anatomical and biomechanical research creates an essential platform for future neuromotor control research, as has happened in the human research model.

These morphological characteristics also reflect the research findings in spinal kinematics performed previously (Townsend *et al*. 1983), where it was shown that the greatest volume of deep epaxial musculature occurs at the point of greatest motion in the spine, the lumbosacral region (Stubbs *et al*. 2006). Further, anatomical variations were noted in the equine lumbosacral region, as previously reported (Haussler *et al*. 1999), occurring in up to a third of horses. The predominant variation was a divergence of the dorsal spinous process between lumbar veterbrae 5 and 6, where the last lumbar vertebrae effectively function as the lumbosacral joint. These variations are likely to have a significant influence on the range of motion and function; and hence performance.

Current epaxial muscle research in the horse involving use of ultrasonography to detect changes in the muscle associated with back pain as has been shown in man (Hides *et al*. 1996), is underway. This may influence the way we diagnose and treat equine back pain as it has in man (MacDonald *et al*. 2006).

Research into the biomechanics and neuromotor control of the human SIJ has contributed to the ability of clinicians to diagnose sacroiliac disease (SID) in man. It has been shown that noninvasive, manual SIJ provocation tests are as predictive for SIJ being the source of pain as diagnostic joint blocks (van der Wurff *et al*. 2006). These tests are described as pain provocation tests for SIJ, and are designed to compress SIJ articular surfaces and/or stress the extra-articular structures of the joint. Manual tests, based on the amount (hypo/hypermobility) and quality of motion (the status of the neuromotor system) at the SIJ, are also used clinically to gather sensitive information regarding the functional status of the SIJ. This includes the degree of movement of the SIJ during application of manual force and, specifically, in analysing movement of the sacrum relative to the pelvis in weightbearing through the pelvis (Lee 2004).

Diagnosis of equine SID, using manual tests similar to that used in man, has been discussed (Haussler 2003; Varcoe-Cocks *et al*. 2006), but recently research documenting motion between sacrum and ilium during the application of manual force has been reported (Goff *et al*. 2006). Manual forces applied by a physiotherapist were used to demonstrate the direction and amount of movement of the ilium relative to a fixed sacrum in an *in vitro* model. The sacroiliac joint has been shown to lie at an angle of 300° to the horizontal (Dalin and Jeffcott 1986) and, as such, the findings of greatest movement were consistent with this anatomical orientation and were in the lateral and oblique planes (Goff *et al*. 2006). The application of this research to horses *in vivo* and in those affected with SID in future studies would support use of manual tests in horses as in man.

Sensorimotor system and peripheral joint function

Another related area of human physiotherapy research with a large impact on treatment and rehabilitation of peripheral joint injuries including the ankle, knee (Lephart *et al*. 1998) and shoulder (Myers *et al*. 2006), as well as prevention of these injuries and maximising performance in athletes, has been research on the sensorimotor system and proprioception of joints (Reinman and Lephart 2002 a,b).

Research in this area involves determining the normal movement and control of movement of any particular joint; and restoration of that control when it is lost due to injury or dysfunction. Stability in a joint is controlled by a combination of its mechanical restraints (e.g. ligaments, joint capsule and bony geometry) and dynamic restraints mediated by the sensorimotor system, including proprioceptive feedback of joint position and neuromuscular control (Myers *et al*. 2006).

Taping techniques are used in man, including athletes, to enhance the sensorimotor system and have been used clinically in horses for similar purposes. The aim of taping is to stimulate mechanoreceptive and proprioceptive activity in the skin, fascia, ligaments and joints. This affects the sensory afferent activity from that region, modulating or altering neuromotor control of locomotion. This is clearly an appropriate area for equine research, yet limited to date.

Patellar taping was shown to improve control of the joint in both pain-free human subjects with poor proprioception of the joint (Callaghan *et al*. 2002) and individuals with femoropatellar pain (Worrell *et al*. 1998; Herrington 2006). Similarly, the combined mechanical and proprioceptive benefits of taping for preventing ankle sprains, as well as recurrence of sprains is well documented (Arnold and Docherty 2004). One study investigated the biomechanical effects of taping the fetlock in the forelimbs of horses (Ramon *et al*. 2004). Although, in this model, mechanical rather than sensorimotor effects were investigated, results suggested that changes seen may be a reflection of proprioceptive adaptations. Effects on ground reaction forces as well and joint ranges of motion were observed and further research is warranted.

Conclusion

There is much scope for more research in equine physiotherapy; however this should be guided by the most recent advances in the human field. Research should be based on a thorough understanding of the basic science underpinning the profession of physiotherapy, especially the neuromotor control and stability model, and the sensorimotor system. We are fortunate that much excellent research already exists in the basic sciences and in equine locomotion and biomechanics, with the rapidly expanding area of functional biomechanics most closely aligned with physiotherapy research. Utilisation of this base knowledge, employing and improving existing research techniques using a human physiotherapy model, should assist in solidifying the evidence base for the exciting new subdiscipline of the physiotherapy profession – Animal Physiotherapy.

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