Table of Contents

In This Issue

Editorial
- Introduction to Neuromuscular Rehab Review. Page 1

Feature Article
- CNS Coordination: A new important sub-classification group. Page 2-5
- Are core stability exercises effective in treating lumbo-pelvic pain? Page 6

Specialist Forum
- Problem solving in specific motor control exercise rehabilitation. Page 7-13

Clinical Tips
- Gluteus maximus: facilitation strategies. Page 13-14

Outcome measures
- STarT Back Tool. Page 15

Topical Debate
- Is central sensitization always co-morbid with psychological conditions? Page 16

One on One Interview
- What is different about SMARTERehab? Page 16-19

Conference Review
- NOI2010: neurodynamics & the neuromatrix conference Page 20

NRI Research Update
- Development of clinical prediction rules. Page 21

New at SMARTERehab
- SMARTERehab Website. Page 22

Journal watch
- Focus on central sensitization. Page 22-24

Book Review
- Diagnostic accuracy. Page 24

Register for this Newsletter

www.smarterehab.com/newsletter

Editorial

Introduction to Neuromuscular Rehab Review

It is with great pleasure that we launch the Neuromuscular Rehab Review (NRR). The musculoskeletal rehabilitation field has progressed a long way in the last decade or so. However people continue to be disabled by their pain and randomized controlled trials continue to produce meagre results for many common interventions. Pain is complex and it is clear that current practice needs to move forward to address this complexity.

When we consider all the factors that present in each person with a chronic pain problem, there appears to be large number of motor changes. Most of the common interventions are based on influencing aspects of these motor function deficits. Less commonly addressed are the numerous changes which can be considered 'central' in nature (e.g. sensory motor, neurocognitive deficits). It should be understood that almost all these deficits are truly central – even the motor changes. We also need to appreciate that when we do an intervention, we are influencing the central nervous system in some capacity.

There is a need for accurate diagnostic and rehabilitation strategies for clients with a greater 'central' component to their pain presentation. We need to understand how current management influences the brain and learn how we can more specifically modify the brain for those with more profound deficits.

It is obvious that with the complexity of pain, one standard intervention is not going to help everyone achieve their goals. There is a growing trend towards sub-classification and clinical prediction rules (CPR). This research direction shows promise for the future to help solve some of our clinical problems. However there are a few problems with sub-classification and CPR. We have developed a clinical and research strategy to help overcome these potential pitfalls.

The Neuromuscular Rehabilitation Institute and SMARTERehab are committed to developing diagnostic and prescriptive clinical prediction rules for effective sub-classification and client management.

The goals of the NRR are to:

- Develop and research new therapies
- Research current neuromuscular interventions
- Disseminate clinically relevant research
- Present clinical information and the application of research
- Facilitate research by clinicians
- Promote evidence based practice
- Challenge current concepts in rehabilitation to stimulate ideas. It is hoped these ideas will stimulate research and lead to changes in clinical practice –with the goal of making the rehabilitation process more effective.
- Provide an avenue to highlight the research from the Neuromuscular Rehabilitation Institute & SMARTERehab

The SMARTERehab Team

Feature Article

Neurocognitive and sensorimotor deficits represent an important sub-classification for musculoskeletal disorders – Central Nervous System Coordination

Sean GT Gibbons BSc (Hons) PT, MSc Ergonomics, PhD (c), MCPA

Note: we would like to thank the editors of the Icelandic Physical Therapy Journal for allowing us to reprint this article. Reference as: Gibbons SGT 2011 Neurocognitive and sensorimotor deficits represent an important sub-classification for musculoskeletal disorders – Central Nervous System Coordination. Icelandic Physical Therapy Journal. 10-12

Introduction

Chronic low back pain presents with a large variety of motor function and central disturbances (Gibbons 2008, 2010a, 2011a). This heterogenous nature of chronic low back pain (LBP) has lead to various sub-classification strategies to aid in rehabilitation. Common sub-classifications in current clinical practice include: patho-anatomical, movement patterns, pain mechanisms, and psychosocial factors. Current strategies for chronic low back pain fail to address the complexities that clients present with. One type of central disturbance that has received little attention are neurocognitive deficits (e.g. concentration, memory, attention), despite being common in whiplash (Kessels et al 2000), fibromyalgia (Sephton et al 2003, Glass 2008, Verdejo-Garcia et al 2009, Park et al 2001, Dick et al 2008), and chronic pain (Sjøgren et al 2005, Dick and Rashiq 2007, Kreitler and Niv 2007).

Neurocognitive deficits should be of interest to Physiotherapists because they are related to sensory motor deficits, coordination deficits, neurological soft signs, and psychological co-morbidities in children with learning disabilities (Barnhart et al 2003, McPhillips and Sheehy 2004, Semiz et al 2008,Mugnaini et al 2009). They have the potential to influence rehabilitation in adults (Gibbons 2009c, 2009d). Further, many interventions require neurocognitive function. Skills such as reading, concentration, memory, attention, visualization and problem solving should not be taken for granted. The purpose is this paper is to describe a sub-classification strategy for neurocognitive deficits and sensory motor deficits relevant to Physiotherapists.

Sub-classification –
Central Nervous System Coordination

There is an overlap in the central nervous system where the processing of neurocognitive function, sensory motor function, movement and psychological function occur. This creates the potential for competition for resources. In a normal brain, resources are allocated effectively. There is only competition when the system is significantly challenged. When there is a deficit in one of these areas, competition may occur for the limited resources and a deficit occurs in one or more areas depending on the prioritization, need for function and initial ability to deal with multiple demands. In the end, function within the central nervous system suffers. This may manifest as reduced motor control, impaired neurocognitive function or a psychological reaction (Gibbons 2011b).

Although, there is a greater prevalence of neurocognitive deficits in populations with pain as noted above, neurocognitive deficits may be present prior to the development of pain. This is evident from two key areas. Approximately 10% of children have a fundamental learning difficulty (Lagae 2008). Another 25% - 45% have a mild learning difficulty. Most children keep their learning difficulty into adulthood (Cousins and Smyth 2003, Shaywitz et al 2008). Mild cognitive impairment (MCI) is a syndrome with neurocognitive deficits greater than that expected for an individual's age and education level but that does not interfere notably with activities of daily life. Prevalence in population-based epidemiological studies ranges from 3% to 19% in adults older than 65 years (Gauthier et al 2006). This shows that in the general population there are a range of neurological, sensory motor and neurocognitive problems.

It is proposed that another sub-classification, Central Nervous System (CNS) Coordination, be considered to identify the spectrum of sensory motor and neurocognitive deficits in the population. CNS Coordination is the ability of the CNS to receive and process sensory motor information, and process cognitive information. The CNS intimately requires

constant feedback from the sensory motor system for postural stability and control of movement. It is critical to appreciate that CNS Coordination deficits do not include just learning difficulties and MCI in the general population that present with musculoskeletal pain. The brain competition model should be further considered here. Sensory motor deficits such as proprioceptive deficits (Heikkila and Wenngren 1998, Treleaven et al 2003, 2005, Brumagne et al 2000, O'Sullivan et al 2003), and tactility (Peters and Schmidt 1991, Wand et al 2010) are common in chronic pain conditions. Motor deficits occur shortly after the onset of pain and continue (Hodges 2003, MacDonald et al 2006). Further, it is difficult to exclude psychological reactions from pain and the injury process. These presentations will add strain to an already challenged CNS (e.g. learning difficulty or mild cognitive decline), however they have the potential to compromise a normal CNS if the deficits are significant enough.

A CNS Coordination deficit is not meant to be a medical condition, but rather used for sub-classification purposes in rehabilitation. The existing diagnoses of learning difficulties and mild cognitive impairment can fall under this heading for sub-classification purposes in rehabilitation. The neurocognitive deficits that occur with pain still require a medical or neuropsychological diagnosis. The concept of brain competition leading to neurocognitive deficits with sensory, motor and psychological competition is a hypothesis at this stage and requires further investigation.

The Motor Control Abilities Questionnaire (MCAQ) is an instrument that was developed to identify neurocognitive and sensory motor deficits along with related symptoms in adults (Gibbons 2009a). The MCAQ has identified three sub-groups of CNS Coordination: significant deficits, mild to moderate deficits; and minimal deficits (Gibbons 2009b). The physical assessment of neurological soft signs and sensory motor function can also identify these subgroups (Gibbons 2009c). The MCAQ's ability to predict if an adult can learn specific motor control exercise for chronic low back pain is very good with a specificity and sensitivity of 0.98 and 0.88, respectively (Gibbons 2009a). The MCAQ along with ruling out high psychosocial and psychological issues make up a clinical prediction rule for who will respond to specific motor control exercise for low back pain (Gibbons 2010b, 2010c).

Relevance

The group with significant CNS Coordination deficits are uniquely different from others in numerous ways. They present with inherently different beliefs related to their presentation and possess numerous risk factors for poor outcome. These include: higher self rated pain, disability, fear avoidance, and psychosocial factors; lower self rated function, and sleep quality. They also have a poor ability to learn specific motor control exercise. Although the presentation is amenable to change, the timeframe is longer than normal and can take three to six months for significant change to take place (Gibbons 2009d).

Rehabilitation

The principles of neuroplasticity must be applied in rehabilitation. Rehabilitation strategies for neurocognitive function come from children with learning difficulties, adults with MCI and stroke sufferers. Our preliminary results show that primitive reflex inhibition, focused attention to sensory motor function and active exercise programs can provide a rehabilitation option for those with significant CNS Coordination deficits (Gibbons 2009d).

Conclusion

Neurocognitive and sensory motor deficits make up an important sub-group of musculoskeletal conditions which we have termed CNS Coordination. A better understanding of the inter-relationships between sensory, motor, neurocognitive and psychological function will increase our knowledge of appropriate intervention strategies.

References

Barnhart RC, Davenport MJ, Epps SB, Nordquist VM 2003 Developmental coordination disorder. Physical Therapy. 83 (8): 722-731

Brumagne S, Cordo P, Lysens R, Verschueren S, Swinnen, S 2000 The role of paraspinal muscle spindles in lumbosacral position sense in individuals with and without low back pain. Spine. 25 (8): 989-94.

Cousins M and Smyth MM 2003 Developmental coordination impairments in adulthood. Human Movement Science. 22: 433-459

Dick BD, Rashiq S 2007 Disruption of attention and working memory traces in individuals with chronic pain Anesth Analg. 104:1223–9

Dick BD, Verrier MJ, Harker KT, Rashiq S 2008 Disruption of cognitive function in Fibromyalgia Syndrome. Pain. 139: 610–616

Gauthier S, Reisberg B, Zaudig M et al 2006 Mild cognitive impairment. Lancet. 367: 1262–70

Gibbons SGT 2008 The Role of Proprioception & Sensory Motor Function in Rehabilitation, Cognitive Function & Outcome Prediction. The 7th National Symposium of the Kuwaiti Physical Therapy Association. November 12-12. Kuwait City, Kuwait

Gibbons SGT 2009a The development, initial reliability and construct validity of the motor control abilities questionnaire. Manual Therapy. 14 (S1): S22

Gibbons SGT 2009b Cognitive learning and sensorimotor function provide a protective effect from disability in low back pain. Manual Therapy. 14 (S1): S30

Gibbons SGT 2009c Neurological soft signs are present more often and to a greater extent in adults with chronic low back pain with cognitive learning deficits. Manual Therapy. 14 (S1): S20

Gibbons SGT 2009d Primitive reflex inhibition and sensory motor training improves cognitive learning function and symptoms in chronic disabling low back pain: A case series. October 30th – Nov 1st, Edinburgh, Scotland. Manual Therapy. 14 (S1): S24

Gibbons SGT 2010a Influence of cognitive learning factors on psychosocial factors and central sensitization. Proceedings of: Neurodynamics & The Neuromatrix Conference. April 15-17, Nottingham, England.

Gibbons SGT 2010b Benefits and limitations with specific motor control rehabilitation Proceedings of: ECT 2010 - “Neurological concepts and impact of manual therapy on pain”, Sept 23-25, Antwerp, Belgium

Gibbons SGT 2010c What exercise for which patient? Prescriptive clinical prediction rules for low back pain. Proceedings of: MACP Conference – “The Great Debate”, Sept 25-26, London, England

Gibbons SGT 2011a Are neurocognitive deficits, psychosocial factors, and musculoskeletal symptoms related? – The Brain Competition Hypothesis. Submitted

Gibbons SGT 2011b What does the heterogeneous group of chronic low back pain consist of? Back to basics for sub-classification. Submitted

Glass JM 2008 Fibromyalgia and cognition. J Clin Psychiatry. 69S (2): 20-24

Heikkila HV, Wenngren BI 1998 Cervicocephalic kinesthetic sensibility active range of movement of cervical motion and oculomotor function in patients with whiplash injury Arch Phys Med Rehabil 79:1089-98

Hodges PW 2003 Core stability exercise in chronic low back pain. Orthop Clin North Am. 34(2):245-254

Lagae L 2008 Learning disabilities: Definitions, epidemiology, diagnosis, and intervention strategies. Pediatr Clin N Am 55: 1259–1268

Kessels RPC, Aleman A, Verhagen WIM, Van Luijtelaar ELJM 2000 Cognitive functioning after whiplash injury: A meta-analysis. Journal of the International Neuropsychological Society. 6: 271–278.

Kreitler S, Niv D 2007 Cognitive impairment in chronic pain. IASP Newsletter. XV (4) July: 1-4

MacDonald DA, Moseley GL, Hodges PW 2006 The lumbar multifidus: Does the evidence support clinical beliefs? Manual Therapy. 11(4): 254-263

McPhillips M, Sheehy N 2004 Prevalence of persistent primary reflexes and motor problems in children with reading difficulties. Dyslexia 10: 316-338

Mugnaini D, Lassi S, La Malfa G, Albertini G 2009 Internalizing correlates of dyslexia. World J Pediatr. 5(4):255-64. Review.

O'Sullivan P**,** Burnett A, Floyd A, Gadson K, Logiudice J, Miller D and Quirke H 2003 Lumbar repositioning deficit in a specific low back pain population. Spine. 28(10): 1074-1079

Park DC, Glass JM, Minear M, Crofford LJ 2001 Cognitive Function in Fibromyalgia Patients. Arthritis & Rheumatism. 44 (9): 2125–2133

Peters ML, Schmidt AJM 1991 A comparison of two-point discrimination threshold of tactual, non-painful stimuli between chronic low back pain patients and controls. Pain. 44: 57-60

Semiz UB, Basoglu C, Oner O, Munir KM, Ates A, Algul A, Ebrinc S, Cetin M 2008 Effects of diagnostic comorbidity and dimensional symptoms of attention-deficit-hyperactivity disorder in men with antisocial personality disorder. The Australian and New Zealand journal of psychiatry. 42(5): 405-13

Sephton SE, Studts JL, Hoover K, Weissbecker I, Lynch G, Ho I, McGuffin S, Salmon P 2003 Biological and psychological factors associated with memory function in fibromyalgia syndrome health psychology. 22 (6); 592–597

Shaywitz SS,Morris R, Shaywitz BA The education of dyslexic children from childhood to young adulthood. Annu. Rev. Psychol. 59:451–75

Sjøgren P, Christrup LL, Petersen MA, Højsted J 2005 Neuropsychological assessment of chronic non-malignant pain patients treated in a multidisciplinary pain centre. European Journal of Pain 9: 453–462

Treleaven J, Jull G, LowChoy N 2005 The relationship of cervical joint position error to balance and eye movement disturbances in persistant whiplash. Manual Therapy

Treleaven J, Jull G, Sterling M 2003 Dizziness and unsteadiness following whiplash injury: characteristic features and relationship with cervical joint position error. J Rehabil Med 35:36-43

Verdejo-Garcı´a A, Lo´pez-Torrecillas F, Calandre EP, Delgado-Rodrı´guez A, Bechara A 2009 Executive Function and Decision-Making in Women with Fibromyalgia. Archives of Clinical Neuropsychology 24: 113–122

Wand BM, Di Pietro F, George P, O'Connell NE 2010 Tactile thresholds are preserved yet complex sensory function is impaired over the lumbar spine of chronic non-specific low back pain patients: a preliminary investigation. Physiotherapy 96: 317–323

How to Sub-classify CNS Coordination

The key part of the clinical prediction rule is the MCAQ©, however there is a physical assessment of sensory motor function and primitive reflexes that accompany this. The medical screening questionnaire and subjective history can help you decide if the MCAQ© needs to be administered or how the physical assessment should be started.

Motor Control Abilities Questionnaire© (MCAQ©)

We have developed a screening questionnaire to predict who will learn specific motor control exercise. The MCAQ© consists mostly of questions relating to sensory motor and neurocognitive function. This questionnaire is highly predictive and forms a critical component of the prescriptive clinical predictive rule. The MCAQ© is available complimentary for one year when you attend one of our training courses. We anticipate it will be for sale in the next few months for those who have not. There will be a small price associated with the questionnaire to help fund our research.

Medical screening questionnaire

To help find out who needs to be given the questionnaire, you can adminster a general medical screening questionnaire to everyone. Many clinics and departments have this anyway. We have added questions related to conditions associated with neurocognitive function and primitive reflexes. This is free for everyone at http://smarterehab.com/assessment-information
Note: this is not the MCAQ©

There are also subjective history questions that should be asked relating to: neurocognitive function, coordination, co-mobidities, neurodevelopment and midline awareness. These are discussed in more detail on our training courses.

Feature Article (Abstract)

Specific motor control exercise for lumbo-pelvic pain of articular origin: A systematic review

Sean GT Gibbons BSc (Hons) PT, MSc Ergonomics, PhD (c), MCPA; Jacqui R Clark GradDip.PT, MSc(c), MCSP, NZRP

Proceedings of: The 3rd International Conference on Movement Dysfunction. "Rehabilitation: Art and Science". October 30th – Nov 1st, Edinburgh, Scotland. Manual Therapy. 14 (S1): S16-17

Introduction

Specific motor control exercises (SME) involving transverus abdominus and lumbar multifidus are commonly used in the treatment of low back pain (LBP). The results of 5 previous reviews suggest SME are better than an inactive control, but not better than other forms of treatment. A washout effect may be occurring due to the heterogeneous nature of chronic low back pain. The purpose of this study was to conduct a systematic review of SME for LBP of articular origin.

Methods

The PEDro scale was used to critique the papers. The levels of evidence used by the Cochrane collaboration were adopted to make recommendations. Only those studies describing an intervention involving SME were included. Inclusion criteria were: the study was an RCT; study group had to receive a SME; the study group had to have articular related pain; the paper had to score 6 or higher on the PEDro scale.

Results

Four papers that met in the inclusion criteria were identified. One study permitted each of the following recommendations: There is moderate evidence for the use of specific stability exercise for articular chronic LBP when used alone or when combined with another form of active treatment. There is moderate evidence for the use of SME for articular sub-acute LBP when combined with another form of active treatment.

Discussion

Although the paper does provide moderate support for the use of SME for LBP of articular origin, there are a number of factors which suggest that the results should be interpreted with caution. This does highlight that a washout effect may have occurred in previous reviews and that there does appear to be a group of clients with LBP that SME can benefit. Further research is highly recommended and some suggestions for future trials are made. It is hoped that this paper will stimulate further discussion and research in this area.

Would you like to write in the NRR?

The NRR is accepting original contributions. Our web site gives an outline of the topics and descriptions of the articles we are interested in. You may be eligible for an "author's grant" if you are currently conducting research. Please check with us for details.

If you see a book or article that you think people should know about, please let us know so we can let others know!

www.smarterehab/newsletter

Specialist Forum

Problem solving in specific motor control exercise rehabilitation

Sean GT Gibbons BSc (Hons) PT, MSc Ergonomics, PhD (c)

Clinicians are constantly being challenged to problem solve in their clinical practice. A unique aspect of this comes into play when teaching clients specific motor control exercise, which involves specific movement patterns or isometric contractions of specific biases towards certain muscles.

Muscles are required for the control of segmental translation, control of posture and control of movement (Hodges 2005). Motor control is simply the strategies used by the central nervous system to control these along coordination and with skilled actions (Shumway-Cook and Woollacott 2011). There is growing evidence to support the use of specific motor control exercise (Gibbons and Clarke 2009, Gibbons and Newhook 2011). These type of exercises represent two sub-components of core stability exercise (see Gibbons 2007a).

Often the success of teaching people these exercises depends upon the skill and experience of the clinician (in the problem solving strategies used), effective communication and the ability of the client to learn. The environment and other factors may also influence this. The Motor Control Abilities Questionnaire was a questionnaire developed to identify people who could and could not learn specific motor control exercise. It consists of questions that primarily deal with neurocognitive and sensory deficits. New research shows that as many as 8% acute low back pain (LBP) and 19% chronic LBP subjects may have significant neurocognitive and sensory deficits and be unable to effectively learn these exercises (Gibbons 2009). Approximately 20% learn the exercises very quickly, however the group in the middle (approximately half) require the clinician to help them with problem solving strategies.

The purpose of this paper is to describe a problem solving model that may aid the clinician in teaching clients various forms of motor control exercise. Figure 1 illustrates the categories of problem solving that can be used and Table 1 highlights the strategies that may be employed. Table 2 describes some exceptions to these strategies. This will be illustrated by an example of the 'neutral' lumbo-pelvic spine. The neutral spine has become somewhat controversial in rehabilitation. It is not the purpose of this article to debate this topic. In brief, this controversy may exist for several reasons. Research in normal subjects in sitting show that most subjects were unable to achieve a short (neutral) lordosis (Claus et al 2009); it is generally considered non functional to stay in one position (and the belief that a neutral spine is one specific position); subjects without LBP tend to move more and are therefore not in a 'neutral' position (Fenety and Walker 2002, Mok et al 2004); epidemiological studies do not support an association between spinal curves and pain (Christensen and Hartvigsen 2008); there is confusion over the concept of the neutral zone put forth by Panjabi (1992) which considers the translation of a joint segment (and related to spinal instability) and the neutral spine position, which relates to the alignment of a spinal region.

A deeper understanding of movement, motor control and sensory motor function shows the short comings of these issues in a debate. There are some points to consider before discounting this type of rehabilitation. Subjects with non specific chronic LBP tend to spend more time closer to their end ranges (O'Sullivan et al 2003) and extended time at end range may reduce proprioception (Dolan and Green 2006). As well, staying stationary with increased stiffness may place more stress on the spine (Hodges et al 2009). This discounts the above argument that subjects with LBP move more and are thus not in neutral. If Panjabi's model (1992) is applied, this may be especially true when the spine is at end range. There is laboratory and clinical evidence of the benefits of using the neutral spine position. Some subjects report a lower sense of effort, report greater confidence in learning and have less superficial muscle activity during specific motor

We should be able to make any exercise harder or easier based upon these variables

Table 1: Variables used to modify specific motor control exercise in clinical problem solving (using the example of a specific motor control neutral in supine crook lying).

Variable	Description & Points of interest	Clinical Example to make the neutral lumbo-sacral spine easier
Sensory motor function	Consists of sensory (vision, vestibular, auditory, olfactory, gustatory, tactility) and motor (muscles, fascia, joints, ligaments and skin). Motor feedback provides proprioceptive and kinaesthetic sense.	Tactility: monitor the rib cage during anterior pelvic tilt to avoid a thoraco-lumbar lordosis
Load	The load of a movement may be modulated by: lever size, external load, friction, gravity, external load, buoyancy	Friction: lie on a smooth surface to allow the gluteals to slide
Range of motion (ROM)	Inner range and outer range influences the force efficiency of a muscle and influences the stretch of passive structures for sensory feedback. Global stability muscles may be more efficient in outer range. With certain movements, there will be a larger load on a body part due to the position of the limb against gravity (e.g. 90° shoulder flexion).	Outer range: start in full flexion and move into extension from this position
Neurocognitive function	Consists of various cognitive functions such as: concentration, memory, attention, problem solving, decision making.	Clear background noise, dim lights and use meditation and mental imagery strategies for focus. This strategy can be made harder by adding tasks such as: counting backwards by 3, recounting directions or a grocery list
Acceleration	The rate of change of velocity over time. It describes the rate of change of both the magnitude and the direction of velocity	Accelerate slowly (use cues such as cold maple syrup or molasses pouring)
Base of support	A base of support can be decreased in size, unstable, movable or have reduced sensory input	Use a firm base of support. Increase base of support by abducting hips.
Movement facilitation	A group of strategies that may be used to facilitate movement or muscular contractions. Motor facilitation: closed chain exercise, associated movements, postural reactions, gym ball movements Motor Sequencing: Modify the sequence of motor commands for a task Unload restrictions to movement: modify a position to take a tissue structure off load to increase movement Control of secondary movement pattern control deficit: active or passively control proximal or distal stability Change position: move to another position for ease of pain, stiffness / restriction, or familiarity or safety Safety & confidence: modify position / surroundings to reduce fear and improve safety.	Unload restriction: Abduct the hips to unload superficial gluteus maximus and the hip joint. *In sitting:* *Unload restriction: raise the seat height and abduct the hips* *Motor facilitation: lift the thoracic spine and then anterior tilt or reverse cues* *Control of secondary movement pattern control deficit: support the thoracic spine with a back to the seat or with co-contraction with protraction of the scapula (hands on the desk).*
Endurance	Endurance is the ability to hold a static position the ability to continue the same task (e.g. repetitions) without a loss of performance	Start without an isometric holding time and just do several repetitions.

control stability exercise in the neutral position (Gibbons et al 2002) and there may be increased (and unwanted) superficial muscle activity during specific motor control exercise when out of neutral in some subjects (Sapsford et al 2001, Gibbons et al 2002).

It should be appreciated that achieving a neutral spine position is primarily a function of superficial or 'global' muscles. The deeper 'local' muscles play a smaller role in producing physiological range of movement. A further description of muscle classification can be seen elsewhere (Gibbons and Comerford 2001). Achieving a neutral spine should be regarded as an element of movement pattern control. This is relevant because subjects with chronic LBP move their spine greater than their hips during trunk flexion compared to subjects without LBP (Gibbons 2011a). For example, anterior pelvic tilt to neutral is relative extension of the spine if the starting position is flexion.

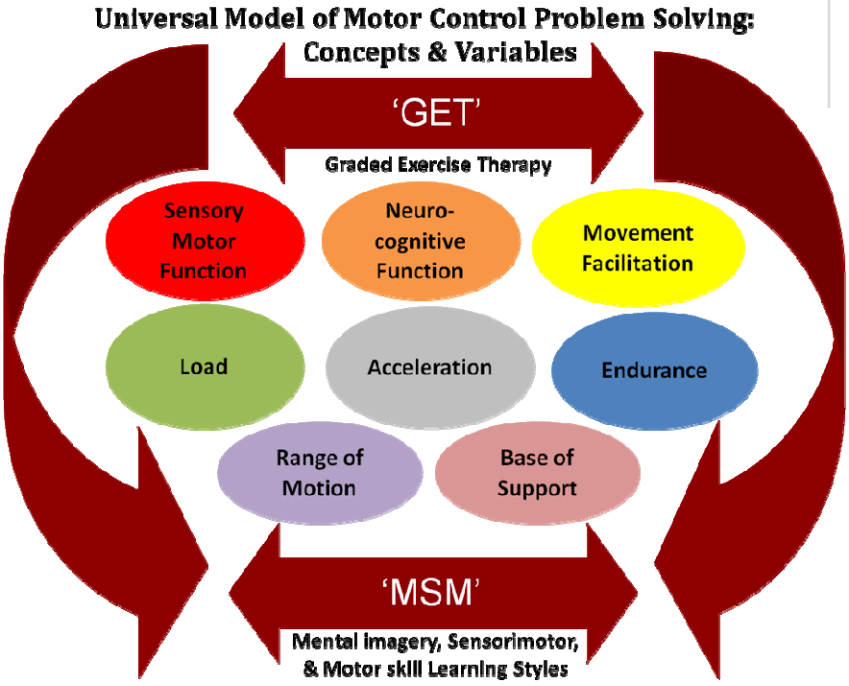


Figure 1: Variables that can be used to modify specific motor control exercise during problem solving to make the exercise easier or more challenging.

Therefore, a neutral spine has the potential to help control movement. One clinical trial provides preliminary evidence of a clinical benefit (Suni et al 2006). Another clinical trial with acute low back pain found a neutral position was able to provide pain control in subjects (Gibbons 2007b).

The neutral position may be defined as a region in which the joints and surrounding passive tissues are in elastic equilibrium and thus in a position of minimal joint load (McGill, 2007). This should not be confused with a neutral spine position in the lumbo-pelvic position. There is some disagreement about what is 'ideal' posture (Claus et al 2009). This may be because a 'neutral' posture or position is different for each individual*. There is also the influence of how one achieves a neutral position. For example, if the larger spinal global mobilizer muscles (e.g. iliocostalis and longissimus) dominate an anterior pelvic tilt, there may be more of a thoracolumbar lordosis and less of a lumbo-sacral lordosis. This clinical observation requires quantitative analysis. Both movements of anterior pelvic tilt may create a 'neutral' position, but the thoraco-lumbar lordosis should not be considered ideal. As well, this movement pattern is not as effective at reducing pain (Gibbons 2007a). Further, the larger global mobilize muscles have large attachments to the rib cage and when contract excessively can have a deleterious influence on breathing.

For the purposes of this article a neutral position may be considered a region midway between an individual's end range position of a joint, or in the case of the spine, the anatomical postural region, that is actively gained by biasing the global stabilizer muscles to achieve this position and held with minimal muscle activity and with normal breathing. It is critical to emphasize that this is not

Table 2: Exceptions to the variables used to modify specific motor control exercise in clinical problem solving

Variable	Exception
Sensory motor function	Some individuals are able to concentrate more with their eyes closed. In most clients and tasks, taking away oculomotor function makes an exercise more difficult
Load	Normally increasing a load will make an exercise harder, however in some clients this provides more sensory feedback and can make an exercise easier
Acceleration	Sometimes moving a limb faster makes the exercise easier rather than harder. This may be because the golgi tendon organ acts as a source of proprioceptive feedback when the muscle spindle does not provide adequate sensory motor feedback.

an exact position, but rather a variable range depending on the individual's available movement. This mid range position is important because stability and proprioception is required from myofascial structures (active mechanisms) rather than ligaments and capsules (passive mechanisms). The range of neutral can also change during the course of rehabilitation if more movement is gained.

Our clinical observations and laboratory findings suggest this strategy results in a better clinical neutral position. To distinguish a general neutral position from the conscious control of the ideal movement pattern biasing the global stabilizer muscles, it may be more appropriate to use the term 'specific motor control neutral'. This would fit in line better with the other terms used in the core stability spectrum of exercises (Gibbons 2007b). For simplicity, this will be referred to as 'specific neutral' for the rest of this article.

The instructions by the clinician to the client in how to achieve the desired movement, or 'cues' are highly variable depending on what is meaningful to the clinician and the client. Common cues usually relate to the most efficient learning style of the client. It is generally accepted that the key learning styles include: auditory, visual, and kinaesthetic / tactile (Fleming 1992). The latter three are commonly employed in specific motor control rehabilitation. Learning style categories may be better considered to be mental imagery, sensorimotor and motor skill to address the more recent advances in learning and neuroplasticity (Gibbons 2011b). People may not be able to understand what learning style they have since it may be a blend of all three. It may be best to problem solve as described below.

It is common to start training the lumbo-pelvic specific neutral region in supine crook lying since the spine is relatively unloaded and this position is often used for pain control in clients with LBP. The flexion of the hips will usually (but not always) create relative spinal flexion so the cues to start here will be related to creating anterior pelvic tilt. Both directions may need to be performed in order to let the client know where "mid range" is. The cues depend on the individual's perception so if they perform posterior pelvic tilt simply use the opposite cue. Table 3 lists common cues used in teaching a specific neutral region. The latter cues are only generally used when the client's understanding and ability is low.

Table 3: Common cues used in achieving a specific neutral region

Common verbal cues
Tip your tailbone forwards (up) / backwards (down)
Tip your pelvis forwards (up) / backwards (down)
Roll your hips forwards / backwards
Place (tip) your tail between your legs and towards the back of your head
Imagine the four corners of the pelvis as a bucket and tip the bucket
Slide your bottom towards your head and your feet
Arch and flatten your back
Lift off and flatten your belt line
Imagine riding a horse or a bike and you have to sit up straight
Imagine a slightly sharp object moving up from the bottom of your back and you have to move away
Place a hand or face cloth (flannel) under the lumbo-sacral junction and move into it or away from it
Tip the head backwards and push heels into bed

Caution should be used here and the client should be suspected of being unable to learn the exercise, which is a CNS Coordination deficit (Gibbons 2011c).

Visual processing: Oculomotor Function, Visual Feedback and Visual Learning

Terminology relating to "visual" descriptions deserves some extra commentary since these seemingly overlapping concepts may be confusing. (1) The oculomotor system has twenty functions to relay the central nervous information about our surroundings, however we are usually only familiar with visual acuity. We can use this oculomotor information to obtain feedback about our environment, our movement, our posture and stability. (2) This is the essence of using visual feedback such as a mirror or real time ultrasound biofeedback or graphical displays with electromyographic feedback. In the example above, the client can watch themselves in a mirror or a pressure biofeedback (see below). (3) A visual learner prefers to receive information through the oculomotor system in order to process it effectively and achieve a skill or store information to later receive it. In this case, they can watch the clinician perform a specific neutral task.

Graded Exercise Therapy & Learning Styles

Graded exercise involves continually improving exercise and activity tolerance utilizing a quota system instead of

pain abatement (Fordyce et al 1973). These principles may need to be used in some individuals. This may be due to concerns regarding pain provocation, extreme fatigue or as a general precaution.

Learning styles have been introduced above. Ideally, the teaching and cueing methods would consider the client's learning style. Most people will have a variable combination of sensory motor learning styles. The ideal learning style is mental imagery (Gibbons 2005). Mental imagery is the ability to perceive an experience that normally requires sensorimotor information or movement, in the absence of the appropriate stimuli. We are more interested in motor imagery (the mental representation of movement without any body movement) in teaching specific motor control exercise. When using motor imagery it is important to ask the client if they are imagining themselves perform the task while inside of their own bodies or if they are imaging watching their self or someone else perform the task. The former is internal motor imagery and the latter two are external motor imagery. Internal mental imagery is associated with better neuroplasticity. Not all people have the ability to perform mental imagery effectively (Dickstein and Deutsch 2007). As a guide, if mental imagery strategies are not effective, sensory motor strategies can be attempted. If these do not work, motor skill tasks can be attempted. Motor skill involves manually facilitating the desired movement with the client and repeating until they can accomplish without the operator. This will almost always require sensorimotor feedback. It should be appreciated that multiple learning strategies and sensory organs are used by individuals simultaneously however one strategy will usually dominate.

Further example – postural stability

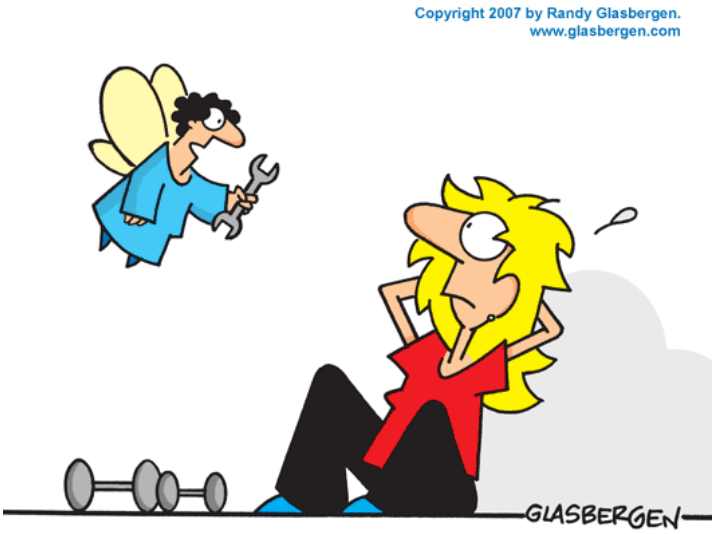
Many of us have been taught to regain proprioception of the leg following a sprained ankle by standing on one leg, closing the eyes and / or standing on a wobble board. Based on the model, we can break this down further. First, this is postural stability, not proprioception, although good sensory motor function is required for good postural stability. Second, when we stand on one leg we are reducing our base of support and a wobble board is using an unstable base of support. Third, when we close our eyes, this is essentially taking away oculomotor function. There are many other ways to challenge this type of exercise requirement. For example, postural stability can be challenged in the Rhomberg or Tandem Rhomberg positions. A useful starting point to challenge oculomotor function may be to ask the client to look side to side (i.e. move the cervical spine and eyes together). We accept that this challenges cervical proprioceptive information and oculomotor function together, however this is arguably more functional (scanning their environment) than having the eyes closed. Smooth pursuit movements, eye stabilization tasks may be used as well. The body can be perturbed by more natural mechanisms such as catching a ball or pendular swinging of the limbs instead of an unstable base.

Integration into function

Training of a specific neutral region is started in a non functional position is started and then gradually progressed into function. This position allows a motor control skill to be acquired. It is often very difficult to start training specific patterns while in loaded or functional positions.

Proprioception & Kinaesthesia

This exercise is easily modified for lumbo-pelvic proprioception and kinaesthesia. The goal is to achieve a lumbo-pelvic neutral position and return there (proprioception: repositioning sense). A pressure biofeedback unit can be used to monitor the starting position. If the client uses the force as feedback rather than the position in space they can use the exercise to match the force (kinaesthesia). These exercises may be performed using a specific neutral region or a traditional neutral.



"I'm the Workout Fairy.
I'm here to tighten your abs!"

Conclusion

A model has been presented that presents problem solving strategies for most exercises in specific motor control rehabilitation and a specific neutral region of the lumbo-pelvic region has been used to help illustrate the concept. The variables can be adapted to make exercises easier for the client or more challenging. They can also be combined together to create numerous challenges for the client. It should be appreciated that this type of rehabilitation is meant for people with only motor function deficits. It is not recommended for those with psychosocial or psychological risk factors for poor outcome, clients with a central sensitization pain mechanism or central nervous system coordination deficit (Gibbons 2011). These should be ruled out using appropriate screening methods prior to commencing to this type of rehab.

* Note: We would like to acknowledge that some of the earlier ideas regarding the concept of the ideal neutral region were done in collaboration with Mark Comerford. The concept that evolved into 'specific motor control neutral' was done independently.

References

Christensen S Hartvigsen J 2008 Spinal Curves and Health: A Systematic Critical Review of the Epidemiological Literature Dealing With Associations Between Sagittal Spinal Curves and Health. Journal of Manipulative & Physiological Therapeutics 31 (9): 690e714.

Claus AP, Hides JA, Moseley GL, Hodges PW 2009 Is 'ideal' sitting posture real?: Measurement of spinal curves in four sitting postures Manual Therapy 14: 404–408

Dickstein R, Deutsch JE 2007 Motor imagery in physical therapist practice. Physical Therapy. 87: 942–953.

Dolan KJ and Green A 2006 Lumbar spine reposition sense: The effect of a 'slouched' posture. Manual Therapy. 11: 202-207

Fenety A, Walker JM 2002 Short-term effects of workstation exercises on musculoskeletal discomfort and postural changes in seated video display unit workers. Phys Ther. 82: 578-589.

Fleming ND, Mills C 1992 *Not Another Inventory, Rather a Catalyst for Reflection*. To 137-155. Improve the Academy. 11:

Fordyce WE, Fowler RS, Lehmann JF, Delateur BJ, Sand PL, Trieschmann RB 1973 Operant conditioning in the treatment of chronic pain. Arch Phys Med Rehabil. 54: 399-408.

Gibbons LA 2005 Personal Communication. Mary Queen of the World School. Special Education Department

Gibbons SGT 2007b A randomized controlled trial of specific motor control stability exercise versus specific directional exercises in acute low back pain. New directions towards prognostic indicators. Proceedings of: The 6th Interdisciplinary World Congress on Low Back Pain. November 7-11, Barcelona, Spain

Gibbons SGT 2007a Sub-classification of core stability exercise for the purpose of a systematic review. Proceedings of: The 6th Interdisciplinary World Congress on Low Back Pain. November 7-11, Barcelona, Spain (available at: www.smarterehab.com/resources/publications)

Gibbons SGT 2009 The development, initial reliability and construct validity of the motor control abilities questionnaire. Proceedings of: The 3rd International Conference on Movement Dysfunction. "Rehabilitation: Art and Science". October 30th – Nov 1st, Edinburgh, Scotland. Manual Therapy. 14 (S1): S22 (available at: www.smarterehab.com/resources/publications)

Gibbons SGT 2011a What does the heterogeneous group of chronic low back pain consist of? Back to basics for sub-classification. Submitted

Gibbons 2011b A reappraisal of learning styles for rehabilitation. NRR. V1, 2. In press

Gibbons SGT 2011 Neurocognitive and sensorimotor deficits represent an important sub-classification for musculoskeletal disorders – Central Nervous System Coordination. Icelandic Physical Therapy Journal. 10-12

Gibbons SGT and Clark J 2009 Specific motor control exercise for lumbo-pelvic pain of articular origin: A systematic review. Proceedings of: The 3rd International Conference on Movement Dysfunction. "Rehabilitation: Art and Science". October 30th – Nov 1st, Edinburgh, Scotland. Manual Therapy. 14 (S1): S16-17

Gibbons SGT Comerford MJ 2001 Strength versus stability. Part 1: Concepts and terms. Orthopaedic Division Review. March / April. 21-27 (available at: www.smarterehab.com/resources/publications)

Gibbons SGT, Holmes MWR, Grandy C, Kean C, Behm DG 2002 Altered hip and trunk muscle recruitment in subjects with chronic low back pain during a specific exercise for the psoas major muscle. Unpublished data. Memorial University of Newfoundland.

Gibbons SGT, Newhook T 2011 Specific movement control exercise for non specific low back pain. A systematic review. Manuscript in preparation.

Hodges PW, Tucker K 2011 Moving differently in pain: A new theory to explain the adaptation to pain. Pain. 152: S90–S98

Hodges P, vandenHoorn W, Dawson A, Cholewicki J 2009 Changes in the mechanical properties of the trunk in low back pain may be associated with recurrence. Journal of Biomechanics 42: 61–66

McGill S 2007. Lumbar spine stability: mechanism of injury and restabilization. In: Liebenson (Ed.), Rehabilitation of the Spine. A Practitioner's Manual. Lippincott Williams and Wilkins

Mok NW, Brauer SG, Hodges PW 2004 Hip strategy for balance control in quiet standing in reduced in people with low back pain. Spine. 29(6):E107–12.

O'Sullivan PB, Burnett A, Floyd A, Gadsdon K, Logiudice J, Miller D, Quirke H, 2003 Lumbar repositioning deficit in a specific low back pain population. Spine 28 (10), 1074–1079.

Panjabi, M., 1992. The stabilising system of the spine. Part 1. Function, dysfunction, adaptation and enhancement. Journal of Spinal Disorders 5, 383e389.

Sapsford RR, Hodges PW, Richardson CA, Cooper DH, Markwell S, Jull GA 2001 Co-activation of the abdominal and pelvic floor muscles during voluntary exercises. Neurourology and Urodynamics 20: 31–42.

Shumway-Cook A, Woollacott MH 2011 Motor Control Translating Research into Clinical Practice - fourth edition Lippincott Williams & Wilkins, Philadelphia

Suni J, Rinne M, Natri A, Statistisian MP, Parkkari J, Alaranta H 2006 Control of the Lumbar Neutral Zone Decreases Low Back Pain and Improves Self-Evaluated Work Ability: A 12-Month Randomized Controlled Study. Spine 31(18): E611–E620

Wallden M 2009. The neutral spine principle. Journal Bodywork and Movement Therapies 13, 350-361

Clinical Tips

Facilitation strategies for gluteus maximus

Sean GT Gibbons BSc (Hons) PT, MSc Ergonomics, PhD (c), MCPA

There is little doubt that gluteus maximus is a very important muscle for the lumb-pelvic-hip region in mechanical pain disorders. In fact, exercises for gluteus maximus are a key part of some clinical prediction rules for significant improvement for several conditions. As well, we feel that gluteus maximus training rehab is integral to hamstring rehab. We have a large case series for hamstring rehab for rugby players from a Canadian rugby team.

The strategies discussed here are useful when: during standing or prone, there is little or no change in gluteus maximus tone during conscious activation, or there is extreme hamstring dominance during movement pattern

Gluteus maximus is one of the best & easiest muscles to rehab for a positive clinical effect in mechanical pain

control testing. We qualify this further on our training courses.

Deep Hip Intrinsic facilitation (Figure 1). This is probably the easiest strategy for people to use. The client lies in prone, flexes the knees to 90°, abducts the hips about 30° and externally rotates the hips to touch at the heels. The instruction is simply to "push your heels together". Use enough force to get an efficient contraction. About 10% of people will experience buttock symptoms with this exercise usually due to piriformis pain. This is usually worth the risk and easily problem solved.

Locust or Landau facilitation (Figure 2). This exercise is harder to perform than above because of the weight of the trunk, but is very effective. The client lies prone and lifts the trunk and hips (locust). If using the Landau reflex, add knee flexion and cervical extension with the arms above the head. Biomechanics, motor control and neurology do not always agree. The rumored spinal compression penalty must be ignored here in favor of the antigravity muscle function and gluteal recruitment. This is a key exercise to reduce the excessive hamstring tone seen in many people. Exercises designed to address the "muscle imbalance" of the gluteus maximus and hamstrings do not always do this.

Side lying hip extension facilitation (Figure 3). This is sometimes inconvenient to do at home, but works very well. The client lays down next to a wall or a hard to move object. They flex the hips (to an angle that effectively lengthens gluteus maximus – usually between 65° - 90°) and then they extend the top hip to create an isometric contraction. They should not flex the knee.

We discuss problem solving strategies and the benefits vs imitations of these on our courses. You can learn more about how we train gluteus maximus and other lumbo-pelvic-hip muscles on the following courses:
Movement Analysis, Sub-classification, Neuromuscular Retraining for Functional Movement Control of the:

- Lumbo-Pelvic Region
- SIJ Load Transfer Efficiency
- Hip & Lower Limb

See the website http://smarterehab.com and go to courses, for a list of course dates.

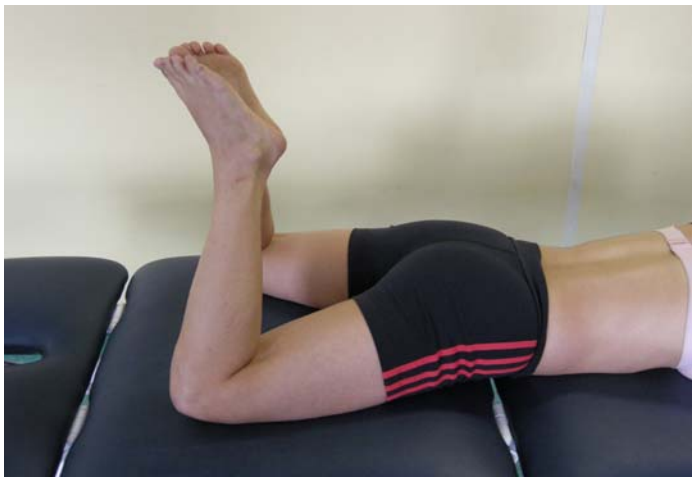


Figure 1: Deep hip intrinsic facilitation of gluteus maximus

Some people seem to present with congenital loss of gluteus maximus, or gluteal amnesia (McGill)!

Figure 2: Locust facilitation of gluteus maximus

Figure 3: Side lying hip extension facilitation of gluteus maximus

Outcome Measures

STarT Back Screening Tool

Sean GT Gibbons BSc (Hons) PT, MSc Ergonomics, PhD (c), MCPA

Background

There are many potential psychological screening tools available to the musculoskeletal clinician. In fact, it is often overwhelming and can lead to neither one being used. The Fear Avoidance Beliefs Questionnaire has received quite a bit of press this last number of years, but it is only one of several psychological domains that a client with pain may present with and it lacks appropriate diagnostic accuracy statistics. The STarT Back Screening Tool consists of the questions that the "worst of the worst" most frequently had to say. The tool and background references can be found at: http://www.keele.ac.uk/research/pchs/pcmrc/dissemination/tools/startback/

No tool captures this high risk group with such a short screen so it is easy to use and score for the clinician. We highly recommend it.

How SMARTERehab uses the questionnaire

One option would be to screen everyone, however we have chosen to only administer the questionnaire to those we feel have psychosocial / psychological risk factors for long term disability. After a pilot study, we found more false positives than we liked (which is good for a screening tool), and using some key aspects from our subjective history, we were able to appropriately apply the STarT Back Screening Tool.

Once someone has been identified as being in the high risk group, we would like to know why they are in that group (e.g. anxiety, depression, stress, fear, psychosocial factors) so we can better address the psychosocial intervention. This can be done with a skilled assessment, a battery of questionnaires (see the website http://smarterehab.com and go to resources / outcome measures), or a referral to someone more qualified. Note: The developer offers training courses and may have different recommendations to this.

Our Research & Future Challenges

There is no perfect screening tool. The STarT Back Screening Tool does not lead us to a diagnosis as to why they are in a high risk group. Further, there will be false negatives that are missed. The Neuromuscular Rehabilitation Institute and SMARTERehab is in the final stages of developing a tool that addresses some of these weaknesses and is a key part of some of our clinical prediction rules.

> "Treating people with a "hands off" approach may be one of the most challenging decisions a muscoloskeletal clinician faces. The Start Back Screening Tool may be one of the best tools to help us make that decision for psychosocial and psychological screening"

The NRISQ© will consist of several parts that help in the diagnosis of central pain, identify specific psychological and psychosocial risk factors and has a work specific component. This has not yet been compared to the STarT Back Screening Tool so we do not yet know if it will compliment, replace or be used as a second tier screening.

In any case, they key takeaway point is that psychological and psychosocial screening is necessary since this group makes up a large component of the group that has a poor outcome from treatment. Screening for this group is now easier and appropriate treatment can be better directed thanks to the STarT Back Screening Tool.

Notes: The STarT Back Screening Tool has only been researched for low back pain. Research is in progress on the generic screening tool (personal communication with Hill J 2010).

Other conditions have questionnaires that have been researched (e.g. whiplash associated disorders: Impact of Events Scale, Neck Disability Index, S-LANSS).

Topical Debate

Is central sensitization always co-morbid with psychological or psychiatric conditions?

Sean GT Gibbons BSc (Hons) PT, MSc Ergonomics, PhD (c), MCPA

There is a general consensus that central sensitization is associated with psychosocial and psychological conditions. One problem is there is a lack of specific diagnostic criteria for central sensitization. There are numerous problems with the proposed descriptions in the literature. For example, There are vast differences in various syndromes which are reported to have 'central pain' (e.g. phantom limb pain and fibromyalgia).

We are one of the first groups to attempt to quantify central sensitization with a standardized laboratory based definition and a clinical prediction rule. A number of psychological and psychosocial based questionnaires were used. None of them were significant in the final logistic regression. Although this may be surprising, our literature search found numerous reasons for reduced central inhibition. Psychological factors are only one of a number of other reasons for central inhibition that contributes to the phenomenon of central sensitization.

The understanding of central pain is certainly critical to the management of musculoskeletal pain syndromes. The next issue of our newsletter will expand upon this further.

One on One Interview

What is unique about SMARTERehab?

Linda French (free lance medical correspondent lindamfrench@gmail.com)

I had the opportunity to sit down with some SMARTERehab group (SRG) members and I wanted to know more about them. I was intrigued by the motivation, knowledge and original ideas of the group to make the rehabilitation process better. What was most interesting was the fact that they are all clinicians who donate time to doing clinically orientated research.

LMF: "What are the differences between SMARTERehab courses and other motor control courses."

SRG: "Many people ask about the differences between SMARTERehab and other motor control courses.

The key difference is that SMARTERehab is ultimately about training the brain for pain, movement and function, but this may seem a little extreme so we need to expand on that.

Let's just break this down. The Key differences in SMARTERehab courses are:

8. We have the most **comprehensive sub-classification methods**
1. And have developed easy use **clinical prediction rules for diagnosis and rehabilitation** for each sub-classification.
2. Our user friendly and **detailed problem solving models** allow you to apply the rehabilitation strategies efficiently
3. With regards to movement, our diagnostic criteria allows us to **identify the mechanism of the loss of movement pattern control**
4. And **we integrate movement into function differently**
5. **Our rehab strategies address the whole body** – from the TMJ to the thumb to the big toe!
6. With regards to pain, we have developed and researched **new strategies to diagnose and rehabilitate pain and psychosocial factors** that are very cutting edge
7. We **provide rehab options for people who cannot learn how to change their movement patterns.** This is our CNS Coordination sub-classification."

LMF: "Can you expand on each of these points?"

SRG: "Absolutely. There are a large number of differences between those who have chronic musculoskeletal symptoms and those who do not. These can be broadly categorized into motor changes and central changes, although we must appreciate that the motor changes are controlled by the central nervous system as well. The problem is, most of the mainstream interventions are based upon the motor changes we see in the literature, but the people who do not get better have more of the central changes. To address the other central and motor changes and we have expanded our sub-classification to include them.

3) We consider the traditional model of **Patho-anatomics** or the tissue stimulus for pain or generator – if that is the correct way to say that. There are adequate diagnostic accuracy statistics for many tissues.
4) **Motor Function which includes: movement pattern control deficits, translation control deficits, respiratory control and motor fitness** which includes: strength, endurance and cardiovascular function. We must consider the latter three issues. We know they provide a benefit to some people, but we don't know exactly why and we don't know how to pick out who will respond to interventions designed to help change these functions. This is an area of ongoing research by our team members.
5) **Pain mechanisms is a complex area.** The original pain mechanisms described by Louis Gifford and Dave Butler are for the most part still considered in the literature today. The main ones are: **nociceptive, neurogenic, neuropathic and central pain**. Others have done great research on most of this. We don't feel central pain has been well described so we have made this a key area of research. We have done some cutting edge research in the diagnosis and rehabilitation of central pain. We'll be able to publish this soon.
6) **Psychological and Psychosocial factors**. This is really two categories that always get lumped together. They should really be considered separately. Our recent research into central pain mechanisms makes us believe this category is much more complex than generally appreciated – if you can believe that! The good news is that we can identify them more quickly than we could before.

1) **Central Nervous System (CNS) Coordination:** This new sub-classification addresses the neurocognitive and sensorimotor status in the population and identifies who will respond well to specific motor control exercise. This is the newest and probably most significant sub-classification. It really helps answer many questions and provides a large missing link in understanding neuromusculoskeletal pain.
2) **Individual factors:** This category considers other deficits that clients present that do not yet fit into a specific category yet, but that we need to appreciate for their management and understanding. Some examples are: hormonal factors, genetic issues and ergonomic or training considerations.

Each sub-classification has an **easy to use diagnostic and prescriptive clinical prediction rule**. To help in the reliability of the assessment, we have several self report questionnaires to help us sub-classify if we need to use them. In brief, we can teach you how to take a subjective history to know if some of the questionnaires need to be administered. The novice can rely on the questionnaires until they gain more experience. In some cases a physical assessment is required or can accompany the questionnaire.

1) The **Patho-anatomics** category requires a physical assessment
2) For **Motor Function,** we use a physical assessment and questionnaire
3) The **Pain mechanisms sub-classification** requires questionnaires and a physical assessment. For example: S-LANSS or PAIN Detect. The NRISQ© will soon be available soon for central pain and psychosocial / psychological factor category.
4) To label **Psychological and Psychosocial factors** we predominately use a questionnaire – StarT Back Screening Tool. This may be the best way to identify high risk groups. We are currently researching another tool to help identify a broader group and address why they are in a high risk group. Other questionnaires can be used for other types of diagnoses. For example, the Impact of Events Scale should be used in whiplash associated disorders.
5) For **CNS Coordination,** the Motor control Abilities Questionnaire© is the primary tool,

however a physical assessment can be used as well.

We should point out that we feel that the first two categories may be the least important in many people. The pain mechanism, psychological status and CNS Coordination all relate to a potentially greater central disturbance. When significant findings are present in either category, they will not respond well to specific motor control interventions. The exception may be neuropathic pain. We feel specific motor control exercise is very important and is one of the foundations of our assessment, but the key is to identify who will respond to these exercises. We have a clinical prediction rule that is very accurate to do this. We also have clinical prediction rules for pain mechanisms. Our clinical prediction rule for psychosocial factors and psychological factors is well underway. There are varying levels of validity associated with these, but our research is aimed at increasing the validity of each of these.

Rehabilitation is rarely as simple as a recipe. Usually there is problem solving and clinical reasoning involved. Our problem solving models and decision making trees greatly assist this process. It is the closest you will get to a recipe while still using good clinical reasoning.

To be fair, there are also some similarities to other motor control courses because one of our goals is to change movement patterns and to provide functional control for rehab of pain and injury**. A major problem with the rehabilitation of movement patterns is that it is done without regard to why the movement pattern actually changed in the first place.** As far as we are aware, we are the first group to specifically make the '**mechanism of the loss of movement pattern'** as part of the diagnostic sub-classification process. This greatly changes the rehab process – for the better. The movement pattern control deficit can be targeted more specifically. For appropriate rehab we must understand how normal movement develops from infancy through primitive reflexes, postural reflexes and goal orientated tasks. It is pretty cool to see how someone's movement pattern changes almost instantly when we rehab their primitive reflexes or postural responses. It makes all the hard work we have done worth it.

Specific movement pattern control exercises are very non functional aren't they? It is not normal to eliminate one part of your kinetic chain during movement. The key bridge here is **kinetic chain sequencing**. This is basically changing the movement pattern towards normal without eliminating one aspect of the kinetic chain. There is an RCT done on low back for this. As well, neurocognitive function and functional sensory challenges are considered. Taken together, the way we integrate into function is fairly different from other people. To help this process, we developed the **Functional Performance Evaluation©.** This is a tool that when used, forces us to think about the mechanism of the movement pattern control deficit, the functional requirements of the client and how we are going to successfully design a program to integrate their specific motor control exercise into their functional needs.

Our courses consider these approaches for all body regions including the TMJ, the thumb and the big toe! One claim to fame we can make is that if you take our series of courses you will be better placed to rehab pretty well every person who comes into your treatment room.

I don't mean to sound like we know how to make everyone better. That is just not possible. Despite our vast knowledge base, there is quite a bit that is unknown about pain and the brain. I think our research into the sub-classification of central pain has allowed us to help another large group of people. The relationship between how the brain interprets body image and psychology is fascinating. We are now successfully tapping into these processes. I think when we understand these processes more, we will be much further ahead again. What we know now is a great foundation to build on for the future.

Because the correction of movement pattern controls deficits is how we approach the average person, depending on your patient population that is, the development and understanding of CNS Coordination has been a huge leap forward for us. It pointed us to look at the brain and central changes, showed us the

interconnections between psychology, motor control, sensorimotor function, neurocognitive function and maybe body image, immune function and endocrine function. It helped us work out treatments for central pain, made us understand the neurodevelopmental process, normal movement and the process of how body image is developed. Specific motor control exercise often receives a bad rap, but as I already mentioned, the key was to learn who will and who will not respond. Once you know who won't respond, you won't waste your time in rehab. This is why the Motor Control Abilities Questionnaire© is such an important tool.

SMARTERehab teaches clinicians to diagnose the dominating characteristics that present with the client to match appropriate rehab to that individual. Our clinical reasoning promotes a four stage process of: Assessment, Sub-classification, Rehabilitate and Re-evaluate. The last stage is a quality assurance stage where we monitor our outcome. If we are not helping people we need to figure out why. Our web site has a list of appropriate and easy to use outcome measures and questionnaires that everyone can access."

LMF: "What is your current research focus?"

SRG: "There are a number of things on our agenda so I'll just give you some highlights. We would like to be able to predict who responds to general exercise such as general strengthening and aerobic exercise. We think it has to do with some physical factors and psychological variables. We are investigating an exercise beliefs questionnaire we developed. Our top priority project involves the sub-classification of central pain. We believe this is very exciting and is a positive step forward in rehab. We are continually working on questionnaire data with the Motor Control Abilities Questionnaire©, the translations and comparing it to other questionnaires. We have been using prospective cohort studies to develop our clinical prediction rules. We plan on starting another clinical trial next year."

LMF: "How have people been responding to your new approach?"

SRG: "The response has been fantastic. It is obvious to most people that there are many unknowns in pain and rehab. People have quickly identified with the concepts we are proposing. Many of the feedback forms have been inspirational. People have commented that the courses are the best they have ever taken. People also like it because it is new. So many of the other courses are just trying to expand on motor control rehab. This has been around for a long time now and is old to many people. People also like the courses because of they are evidence based and fills a large gap in rehab."

SRG: "SMARTERehab courses are developed from recent and ongoing research, with new material drawn from many disciplines including orthopaedic, neurodevelopmental and neurological aspects of human function and rehabilitation. The SMARTERehab system has been developing over the last several years and is now being taught worldwide."

SMARTERehab aims to teach you how to address the real person that walks into the treatment room.

Our series of Movement Analysis and Changing the Brain for Pain, Movement & Function courses will enable you to become a better clinician. Our Sub-classification course may be the most informative course you will ever take.

"Every day for me is an uphill struggle. On the positive side, it's great for my glutes!"

Conference Review

NOI2010: neurodynamics & neuromattrix conference. Nottingham UK, April 15-17

Jacqui R Clark GradDip.PT, MSc(c), MCSP, NZRP

SMARTERehab caused a stir at the NOI conference in the UK in which Sean and other like minded, brain and pain focussed academics and clinicians all converged under the same roof. The sessions were broadly divided into issues relating to neuroplasticity, changing the brain, neurodynamics, motor control, modern pain management, illusions and brain trickery in rehab and many workshops in between. The conference opening session was presented by Jamie Cato, Lead singer of the successful band Faithless, about his real-life experience of chronic pain and how this related directly to his emotional life. Lorimer Moseley discussed brain changes that distort the pain-patient's body image, and spatial neglect and how these can be reversed with discrimination training and mirror box work. Herta Flor discussed cortical plasticity and how the more brain changes take place the more pain there is. Mick Thacker talked about his idea of an "immune-culus", as though there is a little homunculus-like man dictating the body's immune function in the brain. When there is brain neuroplasticity related to pain, immunity is also adversely affected. And the immune system can be responsible for pain, not just the neural system. Sean showed that people with cognitive learning deficits are more susceptible to negative psychosocial factors and central sensitisation; and people with chronic pain have more primitive reflexes present than people without pain. He and I gave practical workshops and have created interest in SMARTERehab in many more countries as a result. David Butler shared his PhD interest in how to effectively teach the patient about their pain. He also intervened part way through the plenary sessions with a mass join-in rendition of "YMCA," with full arm actions, never before seen at an international conference and absolutely indicative of the cohesiveness of all who attended!

Adelaide Australia, April 26-28

Full conference booklet and provisional program now available

www.noi2012.com

8th Interdisciplinary World Congress on Low Back & Pelvic Pain

Dubai
October 27-31, 2013

Intercontinental Hotel Dubai Festival City

info@worldcongreeslbp.com
www.worldcongresslbp.com

Upcoming Conferences SMARTERehab are Presenting at

- **Fifth International Whiplash Trauma Congress**. Lund, Sweden. August 24-28, 2011
- **Journée valaisanne de la physiothérapie 2011**. **Du pied au cerveau - Vom Fuss zum Gehirn**. Sion, Switzerland. September 15, 2011
- **Quebec Manual Therapy Association Symposium (AQPMO).** Montreal, Quebec. February 11, 2012
- **Manitoba Public Case Managers Symposium**. Winnipeg, Manitoba. April 12, 2012

Neuromuscular Rehabilitation Institute Research

Development of clinical prediction rules

Sean GT Gibbons BSc (Hons) PT, MSc Ergonomics, PhD (c), MCPA

Clinical prediction rules (CPR) are becoming common in physiotherapy research and with sub-classification, are considered the way forward in the management of musculoskeletal pain disorders. CPR are a combination of relevant clinical findings to calculate a numeric probability of the presence of a specific disorder or likelihood of an outcome (i.e. they act as adjuncts to the evaluative process) (Beattie et al 2006). There are three types of CPR: diagnostic, prognostic and prescriptive.

Although it takes a long time to fully develop a CPR, a research model to develop preliminary CPR's is relatively inexpensive and easy to do. This model has been described by Cleland et al 2007 (available free – see below) at and replicated by Cai et al 2009, Raney et al 2009, and Gibbons 2010.

A simple, easy to use sub-classification system is recommended in clinical practice (Foster et al 2010). It is our opinion is that chronic pain is not simple and a sub-classification system must be more comprehensive in order to deal with the complexities associated with pain. Our five category sub-classification system addresses all the evidence based variables known to change and influence chronic low back pain. We have developed CPR to diagnose: Central Nervous System (CNS) Coordination deficits and central sensitization. We are also working on strategies to diagnose central pain, psychosocial factors and other complex psychological issues. Some of theseare commonly not addressed or reported on standard self report questionnaires. There are adequate screening tools available to diagnose orthopaedic conditions, neuropathic pain, psychosocial and psychological factors, and motor control deficits.

We have been able to predict who can respond to specific motor control exercise for low back pain. As well, we can predict who can respond to our rehab for CNS Coordination deficits, and central sensitization. Our preliminary data suggest this can also be applied to other body regions and neuropathic pain.

It should be noted that our CPR have varying levels of validation. It is our goal to continue to validate these CPR with high quality clinical trials.

For a full list of references on available CPR see the website http://smarterehab.com /resources / clinical prediction rules.

References

Cia et al 2009 A clinical prediction rule for classifying patients with low back pain who demonstrate short-term improvement with mechanical lumbar traction. Eur Spine J. 18:554–561

Cleland JA et al 2007 Development of a clinical prediction rule for guiding treatment of a subgroup of patients with neck pain: use of thoracic spine manipulation, exercise, and patient education. Physical Therapy. 87:9–23 http://ptjournal.apta.org/

Foster NE, Hill JC, Hay EM 2011 Subgrouping patients with low back pain in primary care: Are we getting any better at it? Manual Therapy 16 (1): 3-8

Gibbons SGT 2010 What exercise for which patient? Prescriptive clinical prediction rules for low back pain. Proceedings of: MACP Conference – "The Great Debate", Sept 25-26, London, England

Raney et al 2009 Development of a clinical prediction rule to identify patients with neck pain likely to benefit from cervical traction and exercise. Eur Spine J. 18:382–391

Free background reading on clinical prediction rules

Beattie P and Nelson R 2006 Clinical prediction rules: What are they and what do they tell us? Australian Journal of Physiotherapy. 52: 157–163 http://www.physiotherapy.asn.au/collections

Beneciuk JM et al 2009 Clinical prediction rules for physical therapy interventions: a systematic review. *Phys Ther*. 89:114–124. http://ptjournal.apta.org/

Childs JD, Cleland JA 2006 Development and application of clinical prediction rules to improve decision making in physical therapist practice. *Phys Ther*. 86:122–131 http://ptjournal.apta.org/

New at SMARTERehab

Web site Development

One of our goals was to make the web site a clinical resource for clinicians. We have been working hard over the summer to update web site. We have updated the following sections that you may find beneficial:

- Outcome measures
- Clinical prediction rules references & summary
- About us videos

Some online courses and the course reference lists are scheduled to be available by the end of September, 2011. The web site will continue to be developed further.

Courses

Due to the massive explosion of research and knowledge about CNS Coordination and Central Pain sub-classifications, we have changed the structure of our courses. We have added a new series of courses - "Changing the Brain for Pain Movement & Function". As well, the Sub-classification course has been fully updated.

Course Updates

We are planning to have course updates to changes in clinical strategies. For example, we have changed the way we do the Spinal Galant, Spinal Perez. As well, we have changed the way we rehab the reflexes in some complex pain clients. Keep an eye on the website for these updates.

Journal Watch

Focus on Central Sensitization

Sean GT Gibbons BSc (Hons) PT, MSc Ergonomics, PhD (c), MCPA

The sub-classification of pain mechanisms is an important part of the management in persons with pain. Central sensitization has received relatively little attention in the literature and is not commonly understood by clinicians. As with psychological and psychosocial issues, it is also challenging to make a diagnosis of central pain mechanisms and take a more non traditional approach (if you are pure manual therapist!). The complicated nature of central sensitization has recently received more attention in the literature. As well, our own research here at NRI and SMARTERehab has helped us make advances in the diagnosis and treatment of central pain (see our next newsletter!). We have included a few abstracts to lead you to some relevant and important reading if you are not familiar with this topic. We encourage you to search the internet and read about this topic as well as other pain mechanisms. It is essential for us a profession to have a better understanding of pain mechanisms. Please send us anything you think is relevant that we can let others know about.

Nijis J et al 2011 How to explain central sensitization to patients with 'unexplained' chronic musculoskeletal pain: Practice guidelines. Manual Therapy. In Press

Abstract

Central sensitization provides an evidence-based explanation for many cases of 'unexplained' chronic musculoskeletal pain. Prior to commencing rehabilitation in such cases, it is crucial to change maladaptive illness perceptions, to alter maladaptive pain cognitions and to reconceptualise pain. This can be accomplished by patient education about central sensitization and its role in chronic pain, a strategy known as pain physiology education. Pain physiology education is indicated when: 1) the clinical picture is characterized and dominated by central sensitization; and 2) maladaptive illness perceptions are present. Both are prerequisites for commencing pain physiology education. Face-to-face sessions of pain physiology education, in conjunction with written educational material, are effective for changing pain cognitions and improving health status in patients with various chronic musculoskeletal pain disorders. These include patients with chronic low back pain, chronic whiplash, fibromyalgia and chronic fatigue syndrome. After biopsychosocial assessment pain physiology education comprises of a first face-to-face session explaining basic pain physiology and contrasting acute nociception versus chronic pain (Session 1). Written information about pain physiology should be provided as homework in between session 1 and 2. The second session can be used to correct misunderstandings, and to facilitate the transition from knowledge to adaptive pain coping during daily life. Pain

physiology education is a continuous process initiated during the educational sessions and continued within both the active treatment and during the longer term rehabilitation program.

Nijis J et al 2010 Recognition of central sensitization in patients with musculoskeletal pain: Application of pain neurophysiology in manual therapy practice. Manual Therapy. 15 (2): 135-141

Abstract

Central sensitization plays an important role in the pathophysiology of numerous musculoskeletal pain disorders, yet it remains unclear how manual therapists can recognize this condition. Therefore, mechanism based clinical guidelines for the recognition of central sensitization in patients with musculoskeletal pain are provided. By using our current understanding of central sensitization during the clinical assessment of patients with musculoskeletal pain, manual therapists can apply the science of nociceptive and pain processing neurophysiology to the practice of manual therapy. The diagnosis/assessment of central sensitization in individual patients with musculoskeletal pain is not straightforward, however manual therapists can use information obtained from the medical diagnosis, combined with the medical history of the patient, as well as the clinical examination and the analysis of the treatment response in order to recognize central sensitization. The clinical examination used to recognize central sensitization entails the distinction between primary and secondary hyperalgesia.

Smart KM et al 2010 Clinical indicators of 'nociceptive', 'peripheral neuropathic' and 'central' mechanisms of musculoskeletal pain. A Delphi survey of expert clinicians. Manual Therapy. 15 (1) 80-87

Abstract

The clinical criteria by which clinicians determine mechanisms-based classifications of pain are not known. The aim of this study was to generate expert consensus-derived lists of clinical criteria suggestive of a clinical dominance of 'nociceptive', 'peripheral neuropathic' and 'central' mechanisms of musculoskeletal pain. A web-based 3 round Delphi survey method was employed as an expert consensus building technique. One hundred and three clinical experts (31 Pain consultants, 72 musculoskeletal physiotherapists) were surveyed. Participants were asked to suggest clinical indicators of three separate categories of pain mechanisms (Round 1), then rate (Round 2) and re-rate their level of agreement/disagreement (Round 3) with those clinical indicators. Consensus was defined by a ≥80% level of agreement. Sixty-two (Response rate, 60%), 60 (58%) and 59 (57%) respondents replied to Rounds 1, 2 and 3 respectively. Twelve 'nociceptive', 14 'peripheral neuropathic' and 17 'central' clinical indicators reached consensus. These expert consensus-derived lists of clinical indicators of 'nociceptive', 'peripheral neuropathic' and 'central' mechanisms of musculoskeletal pain provide some indication of the criteria upon which clinicians may base such mechanistic classifications. Further empirical testing is required in order to evaluate the discriminative validity of these clinical criteria in particular and of mechanisms-based approaches in general.

Woolf CJ 2011 Central sensitization: Implications for the diagnosis and treatment of pain. Pain *152 (3):S2-S15*

Abstract

Nociceptor inputs can trigger a prolonged but reversible increase in the excitability and synaptic efficacy of neurons in central nociceptive pathways, the phenomenon of central sensitization. Central sensitization manifests as pain hypersensitivity, particularly dynamic tactile allodynia, secondary punctate or pressure hyperalgesia, aftersensations, and enhanced temporal summation. It can be readily and rapidly elicited in human volunteers by diverse experimental noxious conditioning stimuli to skin, muscles or viscera, and in addition to producing pain hypersensitivity, results in secondary changes in brain activity that can be detected by electrophysiological or imaging techniques. Studies in clinical cohorts reveal changes in pain sensitivity that have been interpreted as revealing an important contribution of central sensitization to the pain phenotype in patients with fibromyalgia, osteoarthritis, musculoskeletal disorders with generalized pain hypersensitivity, headache, temporomandibular joint disorders, dental pain, neuropathic pain, visceral pain hypersensitivity disorders and post-surgical pain. The comorbidity of those pain hypersensitivity syndromes that present in the absence of inflammation or a neural lesion, their similar pattern of clinical presentation and response to centrally acting analgesics, may reflect a commonality of central sensitization to their pathophysiology. An important question that still needs to be determined is whether there are individuals with a higher inherited propensity for developing central sensitization than others, and if so, whether this conveys an increased risk in both

developing conditions with pain hypersensitivity, and their chronification. Diagnostic criteria to establish the presence of central sensitization in patients will greatly assist the phenotyping of patients for choosing treatments that produce analgesia by normalizing hyperexcitable central neural activity. We have certainly come a long way since the first discovery of activity-dependent synaptic plasticity in the spinal cord and the revelation that it occurs and produces pain hypersensitivity in patients. Nevertheless, discovering the genetic and environmental contributors to and objective biomarkers of central sensitization will be highly beneficial, as will additional treatment options to prevent or reduce this prevalent and promiscuous form of pain plasticity.

Free articles on central sensitization available at:
http://www.ncbi.nlm.nih.gov/sites/gquery

Central Sensitization: A Generator of Pain Hypersensitivity by Central Neural Plasticity Alban Latremoliere and Clifford J. Woolf J Pain. Author manuscript; available in PMC 2010 September 1. PMCID: PMC2750819 Published in final edited form as: J Pain. 2009 September; 10(9): 895–926. doi: 10.1016/j.jpain.2009.06.012.

DeSantana JM and Sluka KA 2008 Central Mechanisms in the Maintenance of Chronic Widespread Noninflammatory Muscle Pain. Curr Pain Headache Rep. 12(5): 338–343.

Meeus M and Nijs J 2007 Central sensitization: a biopsychosocial explanation for chronic widespread pain in patients with fibromyalgia and chronic fatigue syndrome. Clin Rheumatol. 2007 April; 26(4): 465–473.

Book Review

Sean GT Gibbons BSc (Hons) PT, MSc Ergonomics, PhD (c), MCPA

Cook CE, Hegedus EJ 2008 Orthopedic Physical Examination Tests: An Evidence Based Approach. Prentice Hall, Upper Saddle River, NJ. Simply put, this book is a must read for the clinician. At this point, it should be regarded as the 'bible' for summarizing diagnostic accuracy for musculoskeletal clinicians. The beginning of the book does a good job at introducing the concepts and terminology. This book reviews all the standard orthopedic tests in musculoskeletal medicine. They summarize the research based publications of each test with the reliability, validity, specificity, sensitivity, positive and negative likelihood ratios, odds ratio, QUADAS score (see reference below) and a general utility score for each test. The book is well laid out and easy to use. You can simply look up a test if required to quickly do so in the clinic. The book does not include some tests that you may expect it to and some other issues related to the physical assessment (e.g. pain provocation tests) and pain mechanisms (e.g. central sensitization) are not addressed. Self report responses to tests are vulnerable to false positive results when there is significant sensitization present. Diagnostic accuracy is somewhat lacking in the physiotherapy profession. Some institutions of manual therapy and orthopedics do not emphasize these concepts serious enough and do little more than pay lip service to them. Too often, the clinician with the better reputation, more experience or who can shout louder is the one who makes the decision about a test with disregard to the diagnostic accuracy statistics of the test. The profession needs to evolve and this book is a great step in helping summarize a vast amount of information so that it can be disseminated properly. This book is highly recommended.

These publications on diagnostic accuracy are available free after one year and can be found at their association's web site.
http://ptjournal.apta.org/

- Fritz JM, Wainner RS. Examining diagnostic tests: an evidence-based perspective. Phys Ther. 2001;81:1546

http://www.physiotherapy.asn.au/collections

- Davidson M 2002 The interpretation of diagnostic tests: A primer for physiotherapists. Australian Journal of Physiotherapy 48: 227-233

There are free articles at this site as well.
http://www.ncbi.nlm.nih.gov/sites/gquery

- Whitting P, Rutjes AWS, Reitsma JB, Bossuyt PMM, Kleijnen J: The development of QUADAS: a tool for the quality assessment of studies of diagnostic accuracy included in systematic reviews. *BMC Medical Research Methodology 2003, 3(25)*