	APPLIED KINESIOLOGY RESEARCH AND LITERATURE COMPENDIUM: **LOW BACK PAIN CAUSED BY MUSCLE WEAKNESS**
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The effect of chronic low back pain on trunk muscle activations in target reaching movements with various loads. Thomas JS, France CR, Sha D, Vander Wiele N, Moenter S, Swank K.	*Spine.* 2007 Dec 15;32(26):E801-8. **STUDY DESIGN:** A cross-sectional study of the timing of trunk muscle activations between 19 participants with chronic low back pain (LBP) compared with 19 matched controls. **OBJECTIVE:** To determine the effects of target height and load on trunk muscle coordination in whole body reaching tasks, and whether participants with chronic LBP display a shift in trunk muscle coordination performing these tasks. **SUMMARY OF BACKGROUND DATA:** Changes in the precise timing of trunk muscle activation may cause an initial episode of back pain, or contribute to the development of recurrent or chronic symptoms. However, most paradigms used to examine timing of trunk muscle activation did not necessitate large displacements of the trunk. **METHODS:** Participants with and without chronic LBP performed a series of bilateral reaching tasks to 3 target heights with 3 different loads held in the reaching hands. During reaching, joint motions were recorded with an optoelectric system and surface electromyographic signals were collected bilaterally from 5 trunk muscles: rectus abdominis, external oblique, internal oblique, iliocostalis lumborum, and the multifidis, and bilaterally from the deltoid muscle. The onset latencies of the antagonist trunk muscles relative to the deltoid muscle were analyzed to determine the effects of group, target height and load. **RESULTS: Onset of trunk extensor muscles was significantly delayed in participants with chronic LBP compared with control subjects.** Further, the onset latency of the antagonist trunk muscles increased with target distance, but decreased with target load. **CONCLUSION:** These findings suggest that a well documented control strategy generalizes beyond single joint movements and that individuals with chronic LBP display a shift in this strategy.
Back extensor strength and lumbar spinal mobility are predictors of quality of life in patients with postmenopausal osteoporosis. Miyakoshi N, Hongo M, Maekawa S, Ishikawa Y, Shimada Y, Itoi E.	*Osteoporos Int.* 2007 Oct;18(10):1397-403. Epub 2007 Apr 26. **SUMMARY: To assess the effect of multiple factors on quality of life (QOL) in osteoporosis**, relationships between the QOL and possible spinal factors were analyzed in 174 postmenopausal women with osteoporosis. **Back extensor strength and lumbar spinal mobility were the most important factors for QOL in these patients. INTRODUCTION:** Quality of life (QOL) in patients with osteoporosis and vertebral fractures is impaired by the decline of total spinal mobility, although it is not clear to what extent. This study aimed to assess the effect of multiple factors on QOL in patients with osteoporosis. **METHODS:** QOL of 174 postmenopausal women with osteoporosis (mean, 68 years old) was evaluated using the **Japanese Osteoporosis QOL Questionnaire (JOQOL)**. Correlations between the JOQOL score, bone mineral density (BMD) of the lumbar spine/proximal femur/whole body, the kyphosis angle and mobility of thoracic and lumbar spine, the number of vertebral fractures, grip strengths of dominant and non-dominant hands, and isometric back extensor strength (BES) were analyzed. RESULTS: JOQOL showed significant correlation ($p < 0.05$) with age ($r = -0.303$), BES ($r = 0.455$), dominant and non-dominant grip strengths ($r = 0.273$ and $r = 0.255$, respectively), number of vertebral fractures ($r = -0.282$), BMDs of proximal femur and whole body ($r = 0.200$ and $r = 0.157$, respectively), lumbar kyphosis angle ($r = -0.296$), and lumbar spinal mobility ($r = 0.345$). **Multiple regression analysis revealed that the BES and lumbar spinal mobility were the significant contributors to the JOQOL ($p < 0.05$).** **CONCLUSION: BES and lumbar spinal mobility are the important factors for QOL in patients with postmenopausal osteoporosis.**

Assessment of muscle strength of hip joints in children with idiopathic scoliosis, Pingot M, Czernicki J, Kubacki J.	*Ortop Traumatol Rehabil.* 2007 Nov-Dec;9(6):636-43. **BACKGROUND:** The choice of an appropriate approach to the treatment of idiopathic scoliosis is considerably complicated owing to the lack of a clear-cut aetiology of this condition. Idiopathic scoliosis impairs the body's biomechanical balance and adversely affects body statics. **MATERIAL AND METHODS: The muscle torques of the flexor and extensor muscles of the hip joints were assessed in 123 children (96 girls and 27 boys) aged from 8 to 16 with the I degrees scoliosis. Statistically significant differences (p>0.05) were revealed. RESULTS:** The primary lumbar scoliosis was to the left in 109 patients (Group 1) and to the right in 14 patients (Group 2). All children participated in a 6-month exercise programme to strengthen the weakened muscle groups. Torque measurements were performed twice: immediately after the child joined the rehabilitation programme and on completion of the programme. The strength of the weakened muscles was seen to increase to a statistically non-significant level (p>0.05). **CONCLUSIONS:** 1. Exercises strengthening weakened muscles of the hip joint improve the posture of scoliotic children and can be helpful in treating idiopathic scoliosis. 2. **Differences in the strength of the flexors and extensors of the hop joint impair body statics and may constitute one of the causes of idiopathic scoliosis in children.**
Changes in postural activity of the trunk muscles following spinal manipulative therapy. Ferreira ML, Ferreira PH, Hodges PW.	*Man Ther.* 2007 Aug;12(3):240-8. Epub 2007 Apr 23. **Abstract:** Spinal manipulative therapy (SMT) is common in the management of low back pain (LBP) and has been associated with changes in muscle activity, but evidence is conflicting. **This study investigated the effect of SMT on trunk muscle activity in postural tasks in people with and without LBP.** In 20 subjects (10 with LBP and 10 controls), EMG recordings were made with fine-wire electrodes inserted into transversus (TrA), obliquus internus (OI), and externus (OE) abdominis. Rectus abdominis (RA) and anterior deltoid EMG was recorded with surface electrodes. Standing subjects rapidly flexed an arm in response to a light, before and after a small amplitude end range rotational lumbar mobilization at L4-5. In controls, there was no change in trunk muscle EMG during the postural perturbation after SMT. In LBP subjects there was an increase in the postural response of OI and an overall increase in OE EMG. There was no change in TrA or RA EMG. **These results indicate that SMT changes the functional activity of trunk muscles in people with LBP, but has no effect on control subjects. Importantly, SMT increased the activity of the oblique abdominal muscles with no change in the deep trunk muscle TrA, which is often the target of exercise interventions.**
Spinal muscle evaluation in healthy individuals and low-back-pain patients: a literature review, Demoulin C, Crielaard JM, Vanderthommen M.	*Joint Bone Spine.* 2007 Jan;74(1):9-13. Epub 2006 Nov 13. **Abstract:** This article reviews available techniques for spinal muscle investigation, as well as data on spinal muscles in healthy individuals and in patients with low back pain. In patients with chronic low back pain, medical imaging studies show paraspinal muscle wasting with reductions in cross-sectional surface area and fiber density. In healthy individuals, the paraspinal muscles contain a high proportion of slow-twitch fibers (Type I), reflecting their role in maintaining posture. The proportion of Type I fibers is higher in females, leading to better adaptation to aerobic exertion compared to males. Abnormalities seen in paraspinal muscles from patients with chronic low back pain include marked Type II fiber atrophy, conversion of Type I to Type II fibers, and an increased number of nonspecific abnormalities. Limited data are available from magnetic resonance spectroscopy used to investigate muscle metabolism and from near infrared spectroscopy used to measure oxygen uptake by the paraspinal muscles. Surface electromyography in patients with chronic low back pain shows increased paraspinal muscle fatigability, often with abolition of the flexion-relaxation phenomenon. **Comment:** This study demonstrates that LBP usually correlates with demonstrable muscle changes(fatigue) that will most likely to produce weakness upon MMT.

Can the Ileocecal Valve Point Predict Low Back Pain Using Manual Muscle Testing? Pollard HP, Bablis P, Bonello R.	*Chiropr Aust* 2006;36:58-62 **Background:** According to some technique groups in chiropractic the ileocecal valve may malfunction and be associated with a large array of health problems that can lead to common chronic health issues prevalent in our society. Many tests commonly used in chiropractic are presumed to identify painful and/or dysfunctional anatomical structures, yet many have undemonstrated reliability. Despite this lack of evidence, they form the basis of many clinical decisions. One cornerstone procedure that is frequently used by chiropractors involves the use of manual muscle testing for diagnostic purposes not considered orthopaedic in nature. A point of the body referred to as the ileocecal valve point is said to indicate the presence of low back pain. This procedure is widely used in Applied Kinesiology (AK) and Neuro-Emotional Technique (NET) chiropractic practice. **Objective:** To determine if correlation of tenderness of the "ileocecal valve point" can predict low back pain in sufferers with and without low back pain. It was the further aim to determine the sensitivity and specificity of the procedure. **Methods:** One hundred (100) subjects with and without low back pain were recruited. Subjects first completed information about their pain status, then the practitioner performed the muscle testing procedure in a separate room. The practitioner provided either a *yes* or *no* response to a research assistant as to whether he had determined if the subject had back pain based on the muscle test procedure. **Results:** Of 67 subjects who reported low back pain, 58 (86.6%) reported a positive test of both low back pain and ICV point test. Of 33 subjects, 32 (97%) with no back pain positively reported no response to ICV point test. Nine (9) subjects (13.4%) reported false negative ICV tests and low back pain, and 1 subject (3%) reported a false positive response for ICV test and no low back pain. **Conclusion:** The majority of subjects with low back pain reported positive ileocecal valve testing, and all but one of the subjects without low back pain reported negative ileocecal valve testing. The application of ileocecal valve testing as a diagnostic measure of low back pain was found to have excellent measures of sensitivity, specificity and diagnostic competency. This study confirms that the use of this test within the limitations of this study is reliably associated with the presence of low back pain. Further testing is required to investigate all aspects of the diagnostic milieu commonly used by proponents of this form of diagnostic testing. **Comment:** In AK, the ileocecal valve dysfunction is not related automatically to low back pain though this is a frequent consequence of the problem. Another interesting research question that might have been posed to the subjects of this study would have been whether they had experiencing any digestive difficulties and its relationship to positive MMT outcomes. The finding of excellent sensitivity and specificity in this research report is noteworthy.
The association of low back pain, neuromuscular imbalance, and trunk extension strength in athletes. Renkawitz T, Boluki D, Grifka J.	*Spine J.* 2006 Nov-Dec;6(6):673-83. **BACKGROUND CONTEXT:** Imbalanced patterns of erector spinae activity and reduced trunk extension strength have been observed among patients with low back pain (LBP). The association between LBP and neuromuscular imbalance still remains unclear. **PURPOSE:** To examine the relationship between LBP, neuromuscular imbalance, clinical symptoms, and trunk extension strength on two independent occasions, after dynamic neuromuscular changes through a back exercise program. **STUDY DESIGN/SETTING:** Experimental longitudinal study of the lower back in a clinical setting. **PATIENT SAMPLE:** Eighty-two elite amateur tennis players with and without LBP. **OUTCOME MEASURES:** Clinical testing of spinal mobility and muscular flexibility of the lower back. Isometric voluntary maximum trunk extension strength. Surface electromyography (EMG) of lumbar erector spinae. **METHODS:** Athletes underwent a standardized clinical examination with common tests for spinal mobility and muscular flexibility, followed by an isometric trunk extension tests in a specially built apparatus with simultaneous surface EMG recording from right and left lumbar erector spinae. Imbalance quotients were calculated using integrated EMG (IEMG) measures. The relationships between LBP, neuromuscular imbalance, trunk extension strength, and clinical findings were investigated before and after a back exercise program using univariate and multivariate logistic regression models. RESULTS: **A significant association between**

	neuromuscular imbalance of erector spinae and the occurrence of LBP was observed, whereas no significant imbalances were found in subjects without LBP. The number of subjects with LBP decreased proportionally with the occurrence of neuromuscular imbalance in the lumbar region after the completion of a back exercise program. **However, neuromuscular imbalances were still present during retesting among subjects whose LBP did not resolve; the relationship between neuromuscular imbalance of lumbar erector spinae and LBP was significant again.** On the contrary, no significant association between LBP and maximum isometric trunk extension strength or neuromuscular imbalance and maximum isometric trunk extension strength was found before or after the exercise program. No clear relationship between LBP and clinical testing of the lumbar spine or neuromuscular imbalance and clinical testing was found on the two independent testing occasions. **CONCLUSION: A direct relationship between LBP and neuromuscular imbalance was documented in athletes with LBP.** Maximum isometric trunk extension strength had no relationship to the presence of LBP or the occurrence of neuromuscular imbalance of erector spinae. Common clinical testing of spinal mobility and muscular flexibility had only limited correlation to LBP and neuromuscular imbalance. **Comment:** This paper demonstrates what AK physicians find consistently: impairment of muscle strength in patients with low back pain. The "construct validity" of the manual muscle test in the evaluation of patients with low back pain syndromes is presented in this report.
A model of dynamic sacro–iliac joint instability from malrecruitment of gluteus maximus and biceps femoris muscles resulting in low back pain, Hossain M, Nokes LDM.	*Medical Hypotheses*, 2005;65(2):278-281. **Abstract:** The objective of this work is to propose a biomechanical model of sacro–iliac joint dysfunction as a cause of low back pain. Sacro–iliac joint is known to be a source of low back pain. We also know that it is a very stable joint with little mobility. Surrounding lower limb and back muscles contribute a major part of this stability. Gait analysis studies have revealed an orderly sequence of muscle activation when we walk – that contributes to efficient stabilisation of the joint and effective weight transfer to the lower limb. Gluteus maximus fibres-lying almost perpendicular to the joint surfaces are ideally oriented for this purpose. Biceps femoris is another important muscle that can also influence joint stability by its proximal attachment to sacrotuberous ligament. Altered pattern of muscle recruitment has been observed in patients with low back pain. But we do not know the exact cause–effect relationship. Because of its position as a key linkage in transmission of weight from the upper limbs to the lower, poor joint stability could have major consequences on weight bearing**. It is proposed that sacro–iliac joint dysfunction can result from malrecruitment of gluteus maximus motor units during weight bearing. This results in compensatory biceps over activation. The resulting soft tissue strain and joint instability may manifest itself in low back pain.** If our hypothesis holds true, it may have positive implications for patients with sacro–iliac joint dysfunction – who could be offered a definite diagnosis and targeted physiotherapy. It may be possible to identify patients early in a primary care setting and offer direct physio referral. They could benefit from exercises to improve strengthening and recruitment of the affected muscles.
Evaluation of Chapman's neurolymphatic reflexes via applied kinesiology: a case report of low back pain and congenital intestinal abnormality, Caso ML.	*J Manipulative Physiol Ther.* 2004 Jan;27(1):66. (www.journals.elsevierhealth.com/periodicals/ymmt) **Objective**: To describe the applied kinesiologic evaluation of Chapman's neurolymphatic (NL) reflexes in the management of a person with an unusual congenital bowel abnormality and its role in the manifestation of low back pain. The theoretical foundations of these reflexes will be elaborated on and practical applications discussed. **Clinical Features**: A 29-year-old man had chronic low back pain. Radiographs of the patient's lumbar spine and pelvis were normal. Magnetic resonance imaging (MRI) demonstrated a mild protrusion of the fifth lumbar disk. Oral anti-inflammatory agents, cortisone injections, and chiropractic manipulative therapy provided little relief. Though generally in robust health, the patient was aware of a congenital intestinal abnormality diagnosed when he was a child; it was thought to be of no consequence

	with regard to his current back condition. **Intervention and outcome**: The patient's history, combined with applied kinesiology examination, indicated a need to direct treatment to the large bowel. The essential diagnostic indicators were the analysis of the Chapman's neurolymphatic reflexes themselves, coupled with an evaluation of the traditional acupuncture meridians. The primary prescribed therapy was the stimulation of these reflexes by the patient at home. This intervention resulted in the resolution of the patient's musculoskeletal symptomatology, as well as improved bowel function. **Conclusion**: The rather remarkable outcome from the application of this relatively simple, yet valuable, diagnostic and therapeutic procedure represents a thought-provoking impetus for future study and clinical application.
Paraspinal muscles and intervertebral dysfunction: part two, Fryer G, Morris T, Gibbons P.	*J Manipulative Physiol Ther.* 2004 Jun;27(5):348-57. **BACKGROUND:** One of the diagnostic characteristics of the manipulable spinal lesion--a musculoskeletal disturbance that is claimed to be detected with manual palpation and corrected with manipulation--is said to be altered segmental tissue texture. Little evidence for the nature of abnormal paraspinal tissue texture exists, but indirect evidence from experimental studies supports the plausibility of the concept of protective muscle spasm, although investigations of increased paraspinal electromyography (EMG) associated with low back pain suggests complex changes in motor control rather than simple protective reflexes. **OBJECTIVES:** To review the literature for evidence that may support or refute proposed explanations for clinically observed altered paraspinal tissue texture associated with the manipulable spinal lesion. This review aims to highlight areas that require further research and make recommendations for future studies. Data Source MEDLINE and CINAHL databases were searched using various combinations of the keywords paraspinal, muscle, palpation, EMG, spine, low back pain, pain, myofascial, hardness, manipulation, reliability, and somatic dysfunction, along with searching the bibliographies of selected articles and textbooks. Data Extraction All relevant data were used. **RESULTS: Decreased paraspinal muscle activity and strength associated with low back pain is well established**, and there is evidence of changes in muscle fiber composition and localized selective multifidus atrophy. Disturbances in microcirculation have been implicated in nonparaspinal muscle pain. The effect of spinal manipulation on paraspinal EMG activity is inconclusive but promising. **CONCLUSION:** Little direct evidence exists to support the existence or nature of paraspinal tissue texture change that is claimed to be detected with palpation. The proposal of segmental reflex paraspinal muscle contraction was not supported, at least in association with low back pain. There appears to be a complex relationship between deep paraspinal muscle inhibition during dynamic activity and nonvoluntary guarding behavior during static activity. The relationship between these findings and palpable tissue change is speculative, but increased activity, decreased activity, or both may be responsible for paraspinal tissues detected as abnormal with palpation. Recommendations are outlined for future research.
Changes in recruitment of the abdominal muscles in people with low back pain: ultrasound measurement of muscle activity, Ferreira PH, Ferreira ML, Hodges PW.	*Spine.* 2004 Nov 15;29(22):2560-6. **STUDY DESIGN:** Ultrasound and electromyographic (EMG) measures of trunk muscle activity were compared between low back pain (LBP) and control subjects in a cross-sectional study. **OBJECTIVES:** To compare the recruitment of the abdominal muscles (measured as a change in thickness with ultrasound imaging) between people with and without low back pain and to compare these measurements with EMG recordings made with intramuscular electrodes. **SUMMARY OF BACKGROUND DATA:** Although ultrasonography has been advocated as a noninvasive measure of abdominal muscle activity, it is not known whether it can provide a valid measure of changes in motor control of the abdominal muscles in LBP. **METHODS:** Ten subjects with recurrent LBP and 10 matched controls were tested during isometric low load tasks with their limbs suspended. Changes in thickness from resting baseline values were obtained for transversus abdominis (TrA), obliquus internus (OI), and obliquus externus (OE) using ultrasonography. Fine wire EMG was measured concurrently. **RESULTS:** Study participants with LBP had a significantly smaller increase in TrA thickness with isometric leg tasks compared with controls. No difference was found between groups for OI or OE. Similar

	results were found for EMG. People with LBP had less TrA EMG activity with leg tasks, and there was no difference between groups for EMG activity for OI or OE. **CONCLUSIONS:** This study reinforces evidence for changes in automatic control of TrA in people with LBP. Furthermore, the data establish a new test of recruitment of the abdominal muscles in people with LBP. This test presents a feasible noninvasive test of automatic recruitment of the abdominal muscles. **Comment:** Manual muscle testing is an obvious, feasible, and noninvasive test for the adequate recruitment of the abdominal muscles in patients with low back pain. The inhibition of the abdominal muscles in patients with low back pain is a consistent finding in AK therapeutics.
Impaired trunk muscle function in sub-acute neck pain: etiologic in the subsequent development of low back pain? Moseley GL.	*Man Ther.* 2004 Aug;9(3):157-63. **Abstract:** Low back pain (LBP) and neck pain are associated with dysfunction of the trunk and neck muscles, respectively, and may involve common or similar mechanisms. In both cases, dysfunction may compromise spinal control. Anecdotally, neck pain patients commonly develop LBP. **This study investigated the possibility that trunk muscle function is compromised in neck pain patients and that compromised trunk muscle function is associated with increased risk of LBP.** Fifty-four neck pain patients and 52 controls were assessed on an abdominal drawing-in task (ADIT) and on self-report tests. Performance on the ADIT was able to detect neck pain patients with 85% sensitivity and 73% specificity. Catastrophizing and McGill pain questionnaire (affective) scores were higher in patients with an abnormal task response than in patients with an uncertain or normal response, although the self-report data did not predict task performance. Fifty subjects from each group were contactable by telephone at 2 years. They were asked whether they had experienced persistent or recurrent LBP since the assessment. Subjects (patients and controls) who obtained an abnormal response on the ADIT were 3 to 6 times more likely to develop persistent or recurrent LBP than those who obtained an uncertain or normal response. **ADIT performance was the main predictor of development of LBP in patients. The results suggest that reduced voluntary trunk muscle control in neck pain patients is associated with an increased risk of developing LBP.** **Comment:** Impairment of abdominal muscle strength in patients with neck and low back pain are common findings in AK settings. The “construct validity” of the manual muscle test in the evaluation of patients with cervical and low back pain syndromes is presented in this report.
Clinical spinal instability and low back pain. Panjabi MM.	*J Electromyogr Kinesiol.* 2003 Aug;13(4):371-9. **Abstract:** Clinical instability is an important cause of low back pain. Although there is some controversy concerning its definition, it is most widely believed that the loss of normal pattern of spinal motion causes pain and/or neurologic dysfunction. The stabilizing system of the spine may be divided into three subsystems: (1) the spinal column; (2) the spinal muscles; and (3) the neural control unit. A large number of biomechanical studies of the spinal column have provided insight into the role of the various components of the spinal column in providing spinal stability. The neutral zone was found to be a more sensitive parameter than the range of motion in documenting the effects of mechanical destabilization of the spine caused by injury and restabilization of the spine by osteophyle formation, fusion or muscle stabilization. Clinical studies indicate that the application of an external fixator to the painful segment of the spine can significantly reduce the pain. Results of an in vitro simulation of the study found that it was most probably the decrease in the neutral zone, which was responsible for pain reduction. A hypothesis relating the neutral zone to pain has been presented. The spinal muscles provide significant stability to the spine as shown by both in vitro experiments and mathematical models. Concerning the role of neuromuscular control system, increased body sway has been found in patients with low back pain, indicating a less efficient muscle control system with decreased ability to provide the needed spinal stability. **Comment:** Dr. Panjabi is the world’s most published human biomechanical researcher, with over 263 published articles to date. The hypothesis he presents places the functionality of

	muscles, as both a cause and a consequence in chronic back pain patients, at the center of a sequence of events that ultimately results in back pain. The role of the muscular system, as "the stabilizing system of the spine," has been investigated by Dr. Panjabi in numerous other papers.
Pain and motor control of the lumbopelvic region: effect and possible mechanisms, Hodges PW, Moseley GL.	*J Electromyogr Kinesiol.* 2003 Aug;13(4):361-70. **Abstract:** Many authors report changes in the control of the trunk muscles in people with low back pain (LBP). Although there is considerable disagreement regarding the nature of these changes, we have consistently found differential effects on the deep intrinsic and superficial muscles of the lumbopelvic region. Two issues require consideration; first, the potential mechanisms for these changes in control, and secondly, the effect or outcome of changes in control for lumbopelvic function. Recent data indicate that experimentally induced pain may replicate some of the changes identified in people with LBP. While this does not exclude the possibility that changes in control of the trunk muscles may lead to pain, it does argue that, at least in some cases, pain may cause the changes in control. There are many possible mechanisms, including changes in excitability in the motor pathway, changes in the sensory system, and factors associated with the attention demanding, stressful and fearful aspects of pain. A new hypothesis is presented regarding the outcome from differential effects of pain on the elements of the motor system. Taken together these data argue for strategies of prevention and rehabilitation of LBP. **Comment:** In the AK clinical setting, MMT that produces pain during the test will also demonstrate inhibition of the muscle tested. When the proper therapy is employed, the MMT inhibition of the muscle and the pain during the MMT of the muscle are improved. This correlation is explored in this paper.
Evidence of altered lumbopelvic muscle recruitment in the presence of sacroiliac joint pain, Hungerford B, Gilleard W, Hodges P.	*Spine.* 2003 Jul 15;28(14):1593-600. **STUDY DESIGN:** Cross-sectional study of electromyographic onsets of trunk and hip muscles in subjects with a clinical diagnosis of sacroiliac joint pain and matched control subjects. **OBJECTIVES:** To determine whether muscle activation of the supporting leg was different between control subjects and subjects with sacroiliac joint pain during hip flexion in standing. **BACKGROUND:** Activation of the trunk and gluteal muscles stabilize the pelvis for load transference; however, the temporal pattern of muscle activation and the effect of pelvic pain on temporal parameters has not been investigated. **METHODS:** Fourteen men with a clinical diagnosis of sacroiliac joint pain and healthy age-matched control subjects were studied. Surface electromyographic activity was recorded from seven trunk and hip muscles of the supporting leg during hip flexion in standing. Onset of muscle activity relative to initiation of the task was compared between groups and between limbs. **RESULTS**: The onset of obliquus internus abdominis (OI) and multifidus occurred before initiation of weight transfer in the control subjects. The onset of obliquus internus abdominis, multifidus, and gluteus maximus was delayed on the symptomatic side in subjects with sacroiliac joint pain compared with control subjects, and the onset of biceps femoris electromyographic activity was earlier. In addition, electromyographic onsets were different between the symptomatic and asymptomatic sides in subjects with sacroiliac joint pain. **CONCLUSIONS:** The delayed onset of obliquus internus abdominis, multifidus, and gluteus maximus electromyographic activity of the supporting leg during hip flexion, in subjects with sacroiliac joint pain, suggests an alteration in the strategy for lumbopelvic stabilization that may disrupt load transference through the pelvis. **Comment:** The importance of specific treatment of muscle imbalances related to the sacroiliac joints is apparent from this study.
Relationship between hip muscle imbalance and occurrence of low back pain in collegiate athletes: a prospective study, Nadler SF,	*Am J Phys Med Rehabil.* 2001 Aug;80(8):572-7. **OBJECTIVE:** To assess whether athletes with strength imbalance of the hip musculature would be more likely to require treatment for low back pain (LBP) over the ensuing year. **DESIGN:** The study population included 163 National Collegiate Athletic Association

Malanga GA, Feinberg JH, Prybicien M, Stitik TP, DePrince M.	Division I college athletes (100 males and 63 females) undergoing preparticipation sports physicals. Institutional review board approval was obtained to acquire and analyze hip muscle strength data. A commercially available dynamometer (Chatillon, Lexington, KY) incorporated into a specially designed anchoring station was used for testing the hip extensors and abductors. The maximum force generated for the hip abductors and extensors was used to calculate a percentage difference between the right and left hip extensors and abductors. Treatment of athletes by the athletic trainers for LBP unrelated to blunt trauma over the ensuing year was recorded. **RESULTS:** Of all athletes, 5 of 63 females and 8 of 100 males required treatment for LBP. Logistic regression analysis indicated that for female athletes, the percentage difference between the right and left hip extensors was predictive of whether treatment for LBP was required over the ensuing year (P = 0.05). There was no significant association noted for the percentage difference between the right and left hip abductors in females and for the percentage difference between both the right and left hip abductors and right and left hip extensors in males requiring treatment for LBP. **CONCLUSIONS:** These data support our results from our previous cohort study, **adding validity to the concept of hip muscle imbalance being associated with LBP occurrence in female athletes. This research further supports the need for the assessment and treatment of hip muscle imbalance in individuals with LBP. Comment:** The correlation between “inhibited” or “weak” MMT findings and low back pain has been established in much of the research literature. This paper shows that there is a construct validity and reliability in employing MMT testing in patients with low back pain.
Trunk muscle weakness as a risk factor for low back pain. A 5-year prospective study. Lee JH, Hoshino Y, Nakamura K, Kariya Y, Saita K, Ito K.	*Spine.* 1999 Jan 1;24(1):54-7. **STUDY DESIGN:** A 5-year prospective study. **OBJECTIVES: To investigate trunk muscle weakness as a risk factor for low back pain in asymptomatic volunteers. SUMMARY OF BACKGROUND DATA:** Muscle strength has not been sufficiently studied as a risk factor for low back pain. **METHODS:** The study participants included 30 male and 37 female volunteers (mean age, 17 +/- 2 years), who neither reported nor had ever been treated for low back pain. Trunk muscle strength was measured isokinetically (60 degrees/sec), using the trunk extension and flexion and torso rotation units. The peak torques of the volunteers' extension, flexion, rightward rotation, and leftward rotation were measured, and the agonist/antagonist ratios were calculated as extension/flexion and left rotation/right rotation ratio. The volunteers then were followed prospectively for 5 years to determine the incidence of low back pain and were classified into a non-low back pain group (volunteers with no low back pain during the 5-year follow-up period) and a low back pain group (volunteers who experienced low back pain during this period). **RESULTS:** The low back pain group consisted of 8 male and 10 female volunteers. There were no significant differences between the non-low back pain group and the low back pain group regarding age, height, weight, the peak torque values, or the left rotation/right rotation ratio. **However, the extension/flexion ratio of the low back pain group (men, 0.96 +/- 0.27; women, 0.77 +/- 0.19) demonstrated significantly lower values than that of the non-low back pain group (1.23 +/- 0.28 and 1.00 +/- 0.16 for men and women, respectively, P < 0.05). CONCLUSIONS:** An imbalance in trunk muscle strength, i.e., lower extensor muscle strength than flexor muscle strength, might be one risk factor for low back pain.
Muscular strength and chiropractic: theoretical mechanisms and health implications, Smith DL, Cox, RH.	*J Verebralt Subluxation Res,* 3(4), 1999-2000. **Abstract:** To date, a number of studies have investigated the relationships between chiropractic care and muscular strength. Chiropractic practice philosophy states that correction of vertebral subluxation promotes health through enhancing neurological integrity. Accordingly, chiropractic adjustments aimed at reducing vertebral subluxation should also reduce neurological interference at the involved levels. A reduction of interference to the nervous system would thereby allow muscles to more fully express their functional potential, including an improvement in strength. In the present study, a focused discussion is presented relating vertebral subluxation to muscular strength. Consideration is also given to cardiovascular

	regulation as a result of improving neuromuscular function. This is followed by an overview of the principal factors affecting muscular strength. Finally, the relevant chiropractic literature pertaining to strength, with potential mechanisms of action, is discussed. A paradigm shift from a disease treatment model to a health enhancement model of chiropractic is afforded by presenting these concepts and conclusion in the current presentation. **Comment:** The review article demonstrates that 1) the benefits of improved neurological flow of information can improve the functional capabilities of both the muscular and cardiovascular systems, 2) the musculoskeletal/physiological pathways that may account for the efficacy of the adjustment in eliminating fixated joints and improving muscular strength are provided, and 3) clinical MMT, and other forms of testing, should be considered an important way to ascertain and track the patient's neuromuscular status, and that return of muscle strength is a good indicator of the success of that approach.
Inefficient muscular stabilization of the lumbar spine associated with low back pain. A motor control evaluation of transversus abdominis, Hodges PW, Richardson CA.	*Spine*, 1996 Nov 15;21(22):2640-50. STUDY DESIGN: The contribution of transversus abdominis to spinal stabilization was evaluated indirectly in people with and without low back pain using an experimental model identifying the coordination of trunk muscles in response to a disturbances to the spine produced by arm movement. OBJECTIVES: To evaluate the temporal sequence of trunk muscle activity associated with arm movement, and to determine if dysfunction of this parameter was present in patients with low back pain. SUMMARY OF BACKGROUND DATA: Few studies have evaluated the motor control of trunk muscles or the potential for dysfunction of this system in patients with low back pain. Evaluation of the response of trunk muscles to limb movement provides a suitable model to evaluate this system. Recent evidence indicates that this evaluation should include transversus abdominis. METHODS: While standing, 15 patients with low back pain and 15 matched control subjects performed rapid shoulder flexion, abduction, and extension in response to a visual stimulus. Electromyographic activity of the abdominal muscles, lumbar multifidus, and the surface electrodes. RESULTS: Movement in each direction resulted in contraction of trunk muscles before or shortly after the deltoid in control subjects. The transversus abdominis was invariably the first muscle active and was not influenced by movement direction, supporting the hypothesized role of this muscle in spinal stiffness generation**. Contraction of transversus abdominis was significantly delayed in patients with low back pain with all movements.** Isolated differences were noted in the other muscles. CONCLUSIONS: **The delayed onset of contraction of transversus abdominis indicates a deficit of motor control and is hypothesized to result in inefficient muscular stabilization of the spine.** **Comment:** This study elegantly demonstrates that sensory and motor function is integrated, and that improper sequencing of muscle groups results in disjointed movement and pain. AK has argued from its founding that postural control is dependent upon the ability of the individual to properly interpret sensory information and execute an appropriate motor response.
Multifidus muscle recovery is not automatic after resolution of acute, first-episode low back pain, Hides JA, Richardson CA, Jull GA.	*Spine.* 1996 Dec 1;21(23):2763-9. **STUDY DESIGN:** A clinical study was conducted on 39 patients with acute, first-episode, unilateral low back pain and unilateral, segmental inhibition of the multifidus muscle. Patients were allocated randomly to a control or treatment group. **OBJECTIVES:** To document the natural course of lumber multifidus recovery and to evaluate the effectiveness of specific, localized, exercise therapy on muscle recovery. **SUMMARY OF BACKGROUND DATA:** Acute low back pain usually resolves spontaneously, but the recurrence rate is high. Inhibition of multifidus occurs with acute, first-episode, low back pain, and pathologic changes in this muscle have been linked with poor outcome and recurrence of symptoms. **METHODS:** Patients in group 1 received medical treatment only. Patients in group 2 received medical treatment and specific, localized, exercise therapy. Outcome measures for both groups included 4 weekly assessments of pain, disability, range of motion, and size of the multifidus cross-sectional area. Independent examiners were blinded to group allocation. Patients were

	reassessed at a 10-week follow-up examination. **RESULTS:** Multifidus muscle recovery was not spontaneous on remission of painful symptoms in patients in group 1. Muscle recovery was more rapid and more complete in patients in group 2 who received exercise therapy (P = 0.0001). Other outcome measurements were similar for the two groups at the 4-week examination. Although they resumed normal levels of activity, patients in group 1 still had decreased multifidus muscle size at the 10-week follow-up examination. **CONCLUSIONS:** Multifidus muscle recovery is not spontaneous on remission of painful symptoms. **Lack of localized, muscle support may be one reason for the high recurrence rate of low back pain following the initial episode.**
Flexion-relaxation phenomenon in the back muscles. A comparative study between healthy subjects and patients with chronic low back pain, Shirado O, Ito T, Kaneda K, Strax TE.	*Am J Phys Med Rehabil.* 1995 Mar-Apr;74(2):139-44. **Abstract:** At a certain position of trunk flexion, there is a sudden onset of electrical silence in back muscles. This is called "flexion-relaxation (F-R) phenomenon." The goals of this study were (1) to evaluate the relationship between flexion angle and activity of back muscles during flexion movement and (2) to determine what the difference is between healthy subjects and patients with chronic low back pain (CLBP). Twenty-five healthy subjects (13 males and 12 females; average age, 28.3 yr) and 20 patients with CLBP (12 males and 8 females; average age, 34.1 yr) volunteered for this study. The subjects were asked to flex forward maximally from the erect position and to maintain full flexion, followed by returning to the initial upright position. Flexion angle of trunk and hip was measured during the examination. Electromyographic activity of erector spinae was also monitored simultaneously. F-R phenomenon was observed in all healthy subjects before reaching the maximum flexion. Electrical silence continued even after extending the trunk began. In contrast, no patients with CLBP demonstrated F-R phenomenon. A significant difference in muscular activities of erector spinae between the groups was obtained when returning to the erect position from the maximum flexion. Moreover, time lag between trunk and hip movement was much greater in patients than in healthy subjects. **This study demonstrated that neuromuscular coordination between trunk and hip could be abnormal in patients with CLBP.** **Comment:** The key technical factor in the examination of patients with CLBP would be the MMT that makes the detection of the muscular imbalances and aberrant muscular activation patterns cited in this paper identifiable.
Evidence of lumbar multifidus muscle wasting ipsilateral to symptoms in patients with acute/subacute low back pain, Hides JA, Stokes MJ, Saide M, Jull GA, Cooper DH.	*Spine.* 1994 Jan 15;19(2):165-72. **Abstract:** The effect of low back pain on the size of the lumbar multifidus muscle was examined using real-time ultrasound imaging. Bilateral scans were performed in 26 patients with acute unilateral low back pain (LBP) symptoms (aged 17-46 years) and 51 normal subjects (aged 19-32 years). In all patients, multifidus cross-sectional area (CSA) was measured from the 2nd to the 5th lumbar vertebrae (L2-5) and in six patients, that of S1 was also measured. In all normal subjects, CSA was measured at L4 and in 10 subjects measurements were made from L2-5. Marked asymmetry of multifidus CSA was seen in patients with the smaller muscle being on the side ipsilateral to symptoms (between-side difference 31 +/- 8%), but this was confined to one vertebral level. Above and below this level of wasting, mean CSA differences were < 6%. In normal subjects, the mean differences were < 5% at all vertebral levels. The site of wasting in patients corresponded to the clinically determined level of symptoms in 24 of the 26 patients, but there was no correlation between the degree of asymmetry and severity of symptoms. Patients had rounder muscles than normal subjects (measured by a shape ratio index), perhaps indicating muscle spasm. Linear measurements of multifidus cross-section were highly correlated with CSA in normal muscles but less so in wasted muscles, so CSA measurements are more accurate than linear dimensions. The fact that reduced CSA, i.e., wasting, was unilateral and isolated to one level suggests that the mechanism of wasting was not generalized disuse atrophy or spinal reflex inhibition. **Comment:** The researchers in this paper have found lumbar multifidus muscle atrophy occurs in patients with low back pain. In this study, no therapy for this finding was offered, and the

	functional state of these muscles was not evaluated. Were the muscles neurologically inhibited or facilitated; were they capable to functioning better? AK has presented the new principle that the scientific literature had not previously dealt with; the correct form of manual treatment can instantly improve muscle function.
Trunk strength and lumbar paraspinal muscle activity during isometric exercise in chronic low-back pain patients and controls. Cassisi JE, Robinson ME, O'Conner P, MacMillan M.	*Spine.* 1993 Feb;18(2):245-51. **Abstract:** The purpose of this study was to describe trunk strength and lumbar paraspinal muscle activity across five angles of flexion during isometric exercise and rest in chronic low-back pain patients and control subjects. High muscle tension as measured by surface integrated electromyography is predicted by a muscle spasm model, and low muscle tension is predicted by a muscle deficiency model. Prior lumbar surgery had no affect on peak torque or maximum surface integrated electromyography data. Both groups produced greater torque and less surface integrated electromyography in more flexed positions. Chronic low-back pain patients exhibited lower peak torque and lower maximum surface integrated electromyography bilaterally during isometric extension effort across all angles. **A muscle deficiency model of chronic low back pain was supported by these data and a muscle spasm model was not supported.** Discriminant analyses indicated that monitoring maximum surface integrated electromyography of lumbar muscles during isometric effort facilitates classification of chronic low-back pain patients. Future directions are discussed in terms of applying psychophysiologic methods to pain rehabilitation. **Comment:** After 50 years, the research evidence is suggesting the demise of the hyperactivity-causality model for musculoskeletal pain. The lack of convincing evidence to support the belief in hyperactivity as an etiological factor in musculoskeletal conditions has been pointed out in many of the research reviews contained in this compendium. These data indicate that the body's reaction to injury and pain is not primarily increased muscular tension and stiffness; **rather *muscle inhibition is often more significant.*** The later works of Panjabi, Janda, Lewit, Jull, Sahrmann, Bergmark, Hammer and Liebenson have confirmed the findings of Goodheart , the ICAK, and Kendall, showing that muscles predictably respond to pain, inflammation, and/or injury with *weakness*.
The lumbar multifidus muscle five years after surgery for a lumbar intervertebral disc herniation, Rantanen J, Hurme M, Falck B, Alaranta H, Nykvist F, Lehto M, Einola S, Kalimo H.	*Spine.* 1993 Apr;18(5):568-74. **Abstract:** Biopsy specimens of the lumbar multifidus were obtained from 18 patients with lumbar disc herniation at operation and after a postoperative follow-up period of 5 years. The structure and morphometry of the muscle fibers were analyzed and these data were compared with intraoperative biopsy results and the clinical outcome of the operation. The main findings were: 1) on the basis of occupational handicap score 10 patients belonged in the "positive" and 8 in the "negative" outcome group; 2) the intraoperatively recorded selective type 2 muscle fiber atrophy and the extent of pathologic inner structure changes both decreased in the "positive" outcome group, whereas they persisted in the "negative" group; 3) grouping as a definite sign of reinnervation was seen in only two versus four patients of the "positive" versus "negative" outcome group; 4) the relative amount of adipose tissue within the muscle decreased more markedly in the "positive" outcome group. The authors propose that both inactivity and axonal injury (mainly of neurapraxia type) contribute to the selective type 2 atrophy and inner structure changes in disc patients' multifidus muscle. **These pathologic structural changes correlated well with the clinical outcome, and most importantly they are reversible and can be diminished by adequate therapy.**
The stabilizing system of the spine. Part II. Neutral zone and instability hypothesis, Panjabi MM	*J Spinal Disord,* 1992 Dec;5(4):390-6; discussion 397. **Abstract:** The neutral zone is a region of intervertebral motion around the neutral posture where little resistance is offered by the passive spinal column. Several studies--in vitro cadaveric, in vivo animal, and mathematical simulations--have shown that the neutral zone is a parameter that correlates well with other parameters indicative of instability of the spinal system. It has been found to increase with injury, and possibly with degeneration, **to decrease**

	with muscle force increase across the spanned level, and also to decrease with instrumented spinal fixation. In most of these studies, the change in the neutral zone was found to be more sensitive than the change in the corresponding range of motion. The neutral zone appears to be a clinically important measure of spinal stability function. It may increase with injury to the spinal column **or with weakness of the muscles, which in turn may result in spinal instability or a low-back problem**. It may decrease, and may be brought within the physiological limits, by osteophyte formation, surgical fixation/fusion, **and muscle strengthening.** The spinal stabilizing system adjusts so that the neutral zone remains within certain physiological thresholds to avoid clinical instability. **Comment:** Unless there is a bony deformity, muscle imbalance is basic to structural distortion and changes in the motion and positioning of the spinal joints. For distortions in the kinematics of the neutral zone or for spinal subluxations to be maintained, muscle imbalance must be present. Dr. Panjabi's paper once again elucidates several fundamental tenets of AK.
Comparison of lumbar paravertebral EMG patterns in chronic low back pain patients and non-patient controls, Ahern DK, Follick MJ, Council JR, Laser-Wolston N, Litchman H.	*Pain.* 1988 Aug;34(2):153-60. **Abstract:** According to myogenic models that relate abnormal EMG patterns to the experience of pain, lumbar paravertebral muscle activity has been considered to play an important role in chronic low back pain. In the present study, 40 chronic low back pain patients and 40 matched non-patient controls were compared on lumbar paravertebral EMG during mechanically stabilized static and dynamic postures. Differences between groups in lumbar curvature and spinal range of motion were determined using a dual goniometer technique. Although the two groups did not differ on absolute levels of EMG during quiet standing, **significant differences were found for EMG patterns during dynamic postures.** In addition, most patients did not show the flexion-relaxation response or the expected pattern of EMG responses during trunk rotation, most likely because of restricted range of motion and/or compensatory posturing. These findings provide support for the biomechanical model of chronic pain and indicate the need for further research pertaining to pain behavior and movement-related lumbar muscle activity. **Comment:** In this study, chronic low back pain patients were limited in flexion and rotation ROM, which were in turn associated with lower absolute EMG levels. This is consistent with other findings described in this compendium showing lower muscle activities were observed in the chronic low back pain group. A brief survey of the recent scientific literature shows that several dozen investigators were unable to identify reliably increased myoelectric behaviors that correlated to the diagnosis or severity of LBP. From the evidence now available, the hyperactivity-causality model for musculoskeletal pain should be abandoned. It appears to the contrary that muscle weakness or inhibition is the most consistent finding in patients with LBP.
Quantification of lumbar function. Part 2: Sagittal plane trunk strength in chronic low-back pain patients, Mayer TG, Smith SS, Keeley J, Mooney V.	*Spine.* 1985 Oct;10(8):765-72. **Abstract:** A prototype sagittal plane trunk strength tester was used to measure trunk strength in 286 chronic low-back pain patients. Initial data for this patient group are compared with data acquired previously from a group of controls, adjusted for age, sex, and body weight. **Distinct patterns characterize the patient sample as opposed to the controls: Patient values for both flexors and extensors were markedly decreased, with greater variability; Extensor strength was affected more significantly than flexor strength; Discrepancies between patients and controls were greater for females than for males;** High-speed dropoff ratios were much lower for patients, both in flexion and extension. **These results demonstrate that strength deficits are a major factor in the deconditioning syndrome associated with chronic low-back pain.** **Comment:** This test protocol, applied to a symptomatic population, reveals significant global weakness in low back pain sufferers. To test the construct validity of the AK hypothesis that muscle weakness instead of muscle spasm was the cause of spinal pain and dysfunction, researchers have attempted to quantify the muscle weakness that occurs with specific clinical conditions such as low back pain. This paper very elegantly demonstrates one of the prime

	contentions of AK.
The relationship between paraspinal EMG and chronic low back pain. Nouwen A, Bush C.	*Pain.* 1984 Oct;20(2):109-23. **Abstract:** Two models of the relationship between paraspinal EMG and low back pain have been proposed. Specific predictions arising from these are listed and the literature relating to them reviewed. Recent research on patterns of EMG rather than absolute levels is also discussed. **It is concluded that there is no consistent evidence that low back pain patients have elevated paraspinal EMG**, or that its reduction is likely to be an active ingredient in biofeedback therapy. Research on paraspinal EMG patterns is still preliminary, and therefore treatment based on their modification is experimental. **Comment:** After 50 years, the research evidence is suggesting the demise of the hyperactivity-causality model for musculoskeletal pain. The lack of convincing evidence to support the belief in hyperactivity as an etiological factor in musculoskeletal conditions has been pointed out in recent reviews of several chronic musculoskeletal disorders. The research data presented here suggest that the body's reaction to injury and pain is not primarily increased muscular tension and stiffness; **rather *muscle inhibition is often more significant.***
A quantitative study of trunk muscle strength and fatigability in the low-back-pain syndrome. Suzuki N, Endo S.	*Spine.* 1983 Jan-Feb;8(1):69-74. **Abstract:** A quantitative study of the trunk muscle strength and fatigability was performed using an isokinetic dynamometer to determine the role of trunk muscles in the low-back-pain syndrome and in particular to investigate the correlation of trunk muscle strength and lumbar lordosis. **Most patients demonstrated a generalized weakness of the trunk muscles. The trunk muscle strength of patients suffering from backache for less than one month was significantly lower than that of the controls. The strength of the trunk muscles was not influenced by the duration of symptoms.** There was no imbalance between the trunk flexors and extensors. **The patients with back pain had a greater fatigability of the trunk flexors than the controls.** There was negative correlation between the trunk muscle strength or fatigue and lumbar lordosis.
Comparative analysis of paraspinal and frontalis EMG, heart rate and skin conductance in chronic low back pain patients and normals to various postures and stress. Collins GA, Cohen MJ, Naliboff BD, Schandler SL.	*Scand J Rehabil Med.* 1982;14(1):39-46. **Abstract:** Eleven chronic low back pain (CLBP) patients were compared with eleven age-matched controls to different postures and stress while measuring paraspinal and frontalis EMG activity, heart rate and galvanic skin response. **Contrary to current theory, results indicate that the CLBP group exhibited similar or significantly less paraspinal muscle activity than the control group.** Frontalis EMG and skin conductance were significantly higher in the CLBP group. It was concluded that the theories are not supported. An alternative explanation of an increased arousal response and altered ability to respond to demanding tasks leading to pain and eventually to decreased paraspinal muscle activity is suggested. **Comment:** After 50 years, the research evidence is suggesting the demise of the hyperactivity-causality model for musculoskeletal pain. The lack of convincing evidence to support the belief in hyperactivity as an etiological factor in musculoskeletal conditions is clearly pointed out in this study. These data indicate that the body's reaction to injury and pain is not primarily increased muscular tension and stiffness; rather *muscle inhibition is often more significant.*
Trunk muscle strength and low back pain, Thorstensson A, Arvidson A.	*Scand J Rehabil Med.* 1982;14(2):69-75. **Abstract:** The strength of the trunk muscles was measured in a group of young males with low back insufficiency (n=7) and in an age matched (19-21 yrs) healthy control group (n=8). A recently designed new application of the isokinetic technique was used to record maximal torque produced by the trunk muscles during flexion, extension and lateral flexion. Trunk muscle strength was measured during isometric contractions in different trunk positions and during slow isokinetic contractions in the whole range of motion. No significant differences

	between the groups were observed for trunk extension, lateral flexion or flexion with the centre of rotation at L2-L3 level. However, in the initial part of isokinetic trunk flexion with the pivot point at the hip joint the strength values for the back patients were significantly lower than for the controls. **The present results demonstrate the importance of a comprehensive approach to the assessment of trunk muscle strength, including different movement velocities, body positions and pivot points. Further studies are needed to evaluate the significance of the specific weakness observed in dynamic trunk flexion strength in the back patients.**